Guidelines for Mineral Exploration: Environmental, Reclamation and Approval Requirements

Ministry of Energy, Mines
and Petroleum Resources

Honourable Anne Edwards, Minister

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BRITISH COLUMBIA Mining Inspection Regions and Regional Office Locations

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I.

INTRODUCTION

These guidelines are written to inform individuals and companies of the requirements for conducting mineral exploration in the Province of British Columbia in compliance with the *Mines Act* and the *Health, Safety and Reclamation Code for Mines in British Columbia*, with due regard for the Province's other resources. They are intended to ensure that the environmental impacts of mineral exploration are minimized, and that surface disturbances are reclaimed after exploration activities are completed.

This edition replaces the "Guidelines for Mineral Exploration" published in March, 1989.

These guidelines do not outline mineral tenure procedures. For information regarding procedures under the *Mineral Tenure Act* contact one of the offices of the Gold Commissioner (Appendix I).

MINERAL EXPLORATION IN SENSITIVE AREAS

The Ministry of Energy, Mines and Petroleum Resources is committed to integrated resource planning processes in British Columbia, recognizing the need to balance recreation, conservation and environmental goals against the benefits derived from responsible development of our mineral resources. To that end, the Ministry is a full and active participant in the planning and management of a system of protected areas in the Province.

Ministry policy recognizes the importance of sustaining a healthy mineral industry, while at the same time recognizing the need to protect environmentally sensitive areas through close regulation of exploration activities. Sensitive areas include designated recreation areas, forest wilderness areas, community watersheds and wildlife management areas. Through consultation and cooperation with other government agencies and land use planning processes, the Ministry may therefore apply special permit conditions and reclamation guidelines to mineral exploration proposals in these sensitive areas.

CONSULTATION WITH ABORIGINAL PEOPLES

In accordance with the Province's fiduciary responsibilities, the Ministry will undertake all reasonable efforts to minimize the impacts of mineral exploration projects on aboriginal sustenance and cultural activities. Specifically, where potential impacts may exist, the Ministry will consult with aboriginal groups in the project area to explore options to minimize or eliminate adverse effects. Every attempt will be made to render a decision, in a timely manner, which will reconcile the various interests, where feasible.

EXPLORATION FOR URANIUM AND THORIUM

Uranium and thorium exploration is strictly regulated under Part 11 of the *Health, Safety and Reclamation Code for Mines in British Columbia*. Where a person intends to commence exploration in a "designated site" under section 11.4.1 of the *Code*, or encounters uranium, thorium or both at any other site in British Columbia, the Regional Mining Engineer (Appendix I) should be contacted for advice regarding compliance with Part 11.

Exploration for uranium and thorium is not permitted in recreation areas.

II.

LEGISLATION AND APPROVALS

There are several acts and statutes which may govern mineral exploration. Sections 2.1 and 2.2 of this chapter outline the approvals required by the Ministry of Energy, Mines and Petroleum Resources (MEMPR) under section 10 of the *Mines Act* (Appendix A) and the *Health, Safety and Reclamation Code for Mines in B.C.* These approvals generally apply only to exploration work on a mineral title, and do not normally include access roads, campsites or other related developments located off the mineral property.

Section 2.3 of this chapter outlines approvals which may be required from other agencies depending upon the location, land tenure, and nature of the exploration program. Although many of these approvals will be initiated by contact with the Regional Mining Engineer, the responsibility for obtaining these approvals rests with the proponent. Approval to occupy land outside of the mineral property for access roads or other related developments must be obtained from either B.C. Lands, B.C. Parks or the Ministry of Forests as indicated in section 2.3.

Section 2.4 summarizes land ownership rights and the responsibilities of mineral exploration companies under the *Mineral Tenure Act* with respect to exploration on privately owned land.

2.1 MINISTRY OF ENERGY, MINES & PETROLEUM RESOURCES APPROVALS

To initiate all approvals and permits of the Ministry of Energy, Mines and Petroleum Resources an operator must complete a **Notice of Work on a Mineral Property** (Appendix B) and submit it to the Regional Mining Engineer (Appendix I). Depending upon the nature of the exploration program, up to two months may be required before all permits and approvals will be issued. Applications should therefore be initiated well before work is planned.

REQUIREMENT TO GIVE NOTICE (Section 10, Mines Act)

The **Notice of Work on a Mineral Property** must be filed with the Regional Engineer at least 30 days before the intended commencement of exploratory work. Provision of this notice does not, however, imply that the applicant can start work after 30 days. The applicant may only commence work after all approvals and permits have been obtained.

For exploration within a recreation area, the **Notice of Work** must be filed with the Regional Engineer at least 60 days prior to commencing work, and a notice of intent to explore in the recreation area must be published in the Gazette and in a local newspaper. Publishing of a notice of intent to explore in other types of sensitive areas may also be required.

An operator must also provide written notice to the Regional Engineer at least 7 days before the intended cessation of any exploratory work.

APPROVAL OF WORK ON A DESIGNATED SITE (Part 11, Health, Safety and Reclamation Code)

To explore for uranium or thorium or both, or to explore in a designated area under Part 11 of the *Health, Safety and Reclamation Code*, an operator must file the **Notice of Work** with the Regional

Engineer at least 30 days before commencing work, and must also file a notice of the location of the intended exploration in the Gazette and in a local newspaper. The site referred to in the above notice will be considered a "designated site".

If, in the course of exploration at a site other than a designated site, an assay indicates uranium mineralization in an amount of 0.05% or more by weight, or thorium in an amount of 0.15% or more by weight, a **Notice of Work** must be filed within 72 hours of being notified of the assay result.

Under section 11.4.2 of the *Health, Safety and Reclamation Code*, no person may commence exploration at a designated site without the written approval of the Chief Inspector of Mines. To obtain this approval, the applicant must conduct a baseline survey of the designated site in accordance with Schedule B of the *Code* and file a copy of the results of the survey with the Chief Inspector of Mines and the Regional Mining Engineer.

APPROVAL OF UNDERGROUND EXPLORATION WORK (Parts 10 & 11, Health, Safety and Reclamation Code)

These procedures apply to underground exploration including the rehabilitation of workings for the purpose of surveying, mapping, sampling or drilling, and also to underground development work including drifting, cross-cutting, raising and drilling. These procedures do not apply to producing mines.

Under section 11.5.1 of the *Code*, no underground exploration work may commence without the approval of the Regional Engineer. To apply for this approval the following information must be submitted to the regional office in accordance with section 10.1.1 of the *Code*:

- proposed work outlined on a **Notice of Work on a Mineral Property**,
- details of underground work outlined on an **Application for Approval of Underground Exploration Work** (see Appendix C),
- a detailed map of present and proposed underground workings,
- a detailed plan of surface installations in relation to mine openings, and
- the results of acid generation testwork carried out in accordance with section 3.6 of these guidelines.

APPROVAL OF RECLAMATION PROGRAM (Section 10, Mines Act)

Under section 10 of the *Mines Act* the owner, agent or manager of a mine must apply for and obtain a reclamation permit before commencing any work, unless specifically exempted from this requirement in writing by the Chief Inspector of Mines. The procedure for obtaining this permit is outlined below and involves an application, a review by other resource agencies, establishment of special terms and conditions on the permit and placing of a reclamation security deposit.

The amount of security is based on the projected total costs of environmental impact mitigation, including those costs associated with the protection of watercourses, final site reclamation, and any long-term monitoring or effluent treatment.

For exploration within a recreation area the amount of security is also based on the environmental sensitivity of the area and the potential impact of the proposed work, as provided for in section 15 of the *Recreation Area Regulation*.

Procedure for Obtaining a Reclamation Permit

APPLICANT: At least thirty days before commencing work on a mineral property, the applicant submits a completed **Notice of Work on a Mineral Property** to the Regional Mining Engineer.

MEMPR: The Regional Engineer circulates the **Notice of Work** to other government agencies for a referral period of up to 30 days, and advises the applicant of the requirement for reclamation security.

Programs of a sensitive nature such as underground development where there is potential for acid drainage, or exploration in an environmentally sensitive area, may be referred to a Regional Mine Development Review Committee for consideration.

Programs affecting the special interests of other land users will be referred to the appropriate person or group for comment, and may be subject to processes of consultation prior to approval.

APPLICANT: Arranges for reclamation security and forwards the security to the regional office.

MEMPR: At the end of the 30-day referral period the Regional Engineer finalizes permit conditions. Upon receipt of the reclamation security and upon approval of any underground work, uranium/thorium exploration or exploration in a sensitive area, the Regional Engineer will issue the reclamation permit to the operator.

OPERATOR: Upon completion of reclamation work, the operator may request the return of the reclamation security.

MEMPR: Upon request for the return of the reclamation security, the Regional Engineer arranges a property inspection and, if the reclamation program has been carried out and the terms and conditions of the permit met, the security is returned to the operator. If the Regional Engineer is unable to inspect the property at the end of the current field season, the return of securities may be delayed until the following year.

The return of reclamation security for work in a recreation area is subject to agreement by both the Ministry of Energy, Mines and Petroleum Resources and B.C. Parks.

Procedure for Maintaining a Reclamation Permit

Existing permits can be amended by annually submitting a **Notice of Work on a Mineral Property** at least 30 days prior to commencement of new work. Any changes or additions to the work program will be reviewed in the same manner as the original program and may be subject to additional security. Upon approval of the amended program and receipt of any additional security that may be required, the existing permit will be amended to approve the proposed work.

GENERAL RECLAMATION PERMITS

General reclamation permits may be issued by the Chief Inspector of Mines to those companies which maintain a number of exploration projects. This general permit can be used to cover several exploration projects, provided the total unreclaimed area of disturbance of all projects is maintained at under 5 hectares. The company is still required to submit an annual **Notice of Work on a Mineral Property** for each project to the Regional Mining Engineer for review and approval .

Properties of over 5 hectares disturbance or with ongoing exploration programs may require a separate permit and security.

Exploration projects located within a recreation area can not be included under a general reclamation permit.

Procedure for Obtaining a General Mineral Exploration Permit

APPLICANT: Sends a letter to the Chief Inspector of Mines requesting a general reclamation permit and including a summary of each property:

- o name of property,
- o location,
- o owner / operator, and
- o proposed surface disturbance on each property.

MEMPR: Following referral of the application to other government agencies, permit conditions will be finalized and the applicant notified of the requirement for security.

APPLICANT: Arranges reclamation security and forwards this security to MEMPR.

MEMPR: Upon receipt of securities the permit will be issued by the Chief Inspector of Mines.

Procedure for Maintaining a General Mineral Exploration Permit

To maintain an existing general permit, the operator must annually submit a report summarizing work done and work proposed for each property.

Also, a **Notice of Work on a Mineral Property** must be filed with the Regional Engineer at least 30 days before commencement of any new work on any property. Upon approval of the new work and receipt of any additional security that may be required, the existing permit will be amended to approve the proposed work.

2.2 WORK REQUIREMENTS UNDER THE MINES ACT

Under section 1 of the *Mines Act*, a "mine" is any place where mechanical disturbance or excavation of the ground is made to explore for minerals, and includes cleared areas, machinery and equipment, mine buildings, and any exploratory drilling, excavating, waste disposal and site reclamation.

All work in and about a mine must be carried out in accordance with the *Mines Act*, including:

- o A manager must be appointed under section 21 of the *Mines Act*, and must attend daily at an active mine property. This person may also act as a shiftboss if he has the necessary certification.
- o All underground work must be under the supervision of a certified shiftboss. The shiftboss must ensure that all work in and about the mine is in compliance with the *Mines Act*.

- A medical surveillance program must be made available to all persons working in occupations exposed to dust, excessive noise, or specified chemical, physical or radiation agents.

- The ventilation system must meet the requirements of the *Mines Act* and be maintained by the manager to the satisfaction of the District Inspector of Mines.

- A permit must be obtained from the Chief Inspector of Mines for each diesel engine used underground. To apply, submit an **Application for a Permit to Operate a Diesel Engine Underground** (Appendix D) to the District Inspector. Forced ventilation requirements and equipment are to be described and detailed on plans. Gas testing equipment and a record book are to be kept up to date by the shiftboss.

- A permit to store and use explosives at a mine must be obtained from the District Inspector. To apply, submit an **Application for B.C. Explosive Storage & Use Permit** (Appendix E). A permit will be granted if the mine complies with explosives and blasting regulations of the *Mines Act* and the federal *Explosives Regulations*.

- All machines must be muffled to the approval of the Environmental Control Inspector, and operators must have personal hearing protection (muffs).

- All buildings must meet the requirements of the *B.C. Building Code* and the *Electrical Code V*.

- First aid must be maintained in compliance with the Workers' Compensation Board regulations and Part 11 of the *Health, Safety and Reclamation Code for Mines in British Columbia*.

2.3 SUMMARY OF OTHER LEGISLATIVE REQUIREMENTS

B.C. LANDS

With the exception of mine access roads located within a Provincial Forest, which are regulated by the Ministry of Forests, B.C. Lands administers the use of provincial Crown land under the *Land Act*. B.C. Lands approval is required where Crown land is used for mining purposes off a mineral property, or for non-mining purposes on a mineral property. B.C. Lands may also provide *Land Act* tenure for industrial facilities located on a mineral property if requested by the mineral tenure holder for financial or security purposes.

To acquire surface tenure under the *Land Act*, contact a regional office of B.C. Lands (see Appendix I).

B.C. PARKS

Mineral exploration in recreation areas established under the *Park Act* is regulated jointly by the Ministry of Energy, Mines and Petroleum Resources and B.C. Parks under the regulations of the *Mineral Tenure Act* and the *Park Act*.

Specific work proposals may be subject to operational constraints and higher security deposits in order to protect recreationally or environmentally sensitive areas. The reclamation permit will also

constitute a Resource Use Permit under the *Park Act*, and will be jointly approved by the Chief Inspector of Mines and the Regional Director of Parks. Road access to the mineral property and any other work proposed off the property also require a Resource Use Permit and must also be jointly approved by the Chief Inspector of Mines and the Regional Director of Parks.

A joint inspection of the property by the District Inspector of Mines and the Regional Director of Parks may be required prior to commencement of work.

Notwithstanding permits required by B.C. Environment, any use or diversion of water or any discharge of solid or liquid waste in a recreation area must also be approved by the Regional Director of Parks.

B.C. ENVIRONMENT - FISH AND WILDLIFE BRANCH

Responsibility for protection of fish and wildlife habitat rests with the Fish and Wildlife Branch who review the **Notice of Work on a Mineral Property** on referral by the Regional Mining Engineer. Special conditions necessary to minimize impacts on fisheries and wildlife habitat are included in the reclamation permit.

The Wildlife Branch also administers the guide/outfitting and trapping industries, and may therefore set specific conditions for the protection of these licensed users.

B.C. ENVIRONMENT - ENVIRONMENTAL PROTECTION PROGRAM

Sewage Disposal

Pursuant to the *Waste Management Act*, a Waste Management Permit or Approval is required for the discharge of sewage effluent either directly to an open watercourse or, if discharged at a design capacity rate of 22.3 cubic metres per day (5000 gal/day) or more, to the ground. A design capacity discharge rate of less than 22.3 cubic metres per day is covered by the Ministry of Health under the *Public Health Act* and authorization must be obtained from that Ministry.

Refuse Disposal

Under the *Waste Management Act Regulations*, the discharge of solid domestic waste at an exploration camp does not require a Waste Management Permit or Approval if a properly designed incinerator is used. For camps under 10 person capacity, a Yukon type incinerator is acceptable. For camps having a 10 to 99 person capacity, incinerators having refractory linings, auxiliary air and combustion control systems are required.

Refuse in the camp must be collected and incinerated on a daily basis in such a manner as to minimize conflicts with wildlife. Residue from incineration must be disposed of in a manner approved by the Regional Environmental Protection Manager. Otherwise, refuse must be removed from the camp site and deposited in an authorized landfill.

All inert, non-combustible refuse such as fuel drums, broken rigging and other construction or drilling refuse must be removed from the site at the end of operations. Such materials should be recycled for future use or, where appropriate, deposited in an authorized landfill.

Effluent Discharges

Effluent from drilling operations must be discharged to the ground with no direct overland drainage to an open watercourse. Where required by the Regional Environmental Protection Manager, discharges resulting from exploration activities must be treated prior to release to the environment.

Water to be pumped out of old workings must be analyzed for pH, sulphate, alkalinity, dissolved metals and suspended solids, and the results must be submitted to the Environmental Protection Program regional office (see Appendix I) to obtain approval for discharge to the environment.

Acid Generation Potential

When pyritic ores or host rocks are encountered, acid generation potential should be determined as early as possible during the exploration program. Acid generating material may require special handling to prevent acid mine drainage. The results of acid generation characterization tests required under section 3.6 of these guidelines must be submitted to the Environmental Protection Program regional office (see Appendix I).

Fuel Storage

B.C. Environment bulk fuel storage guidelines have been drawn from the Provincial Fire Code. Secondary containment is required and must be sized to accommodate 110% capacity of a single tank installation. The containment must be constructed and maintained to ensure impermeability, and must be placed in a location far removed and, if possible, sloped away from any open watercourse. An oil/water separator must be used when removing collected water from the containment.

Spill Reporting

Pursuant to the *Waste Management Act* all spills of fuel or other hazardous materials must be reported immediately to the Environmental Protection Program. **To report a spill, phone 1-800-663-3456 toll free 24 hours per day.**

B.C. ENVIRONMENT - WATER MANAGEMENT BRANCH

Under the *Water Act*, a water licence or approval may be required for the diversion and use of water from a stream, or for any alterations or changes in and about a stream. A stream is defined under the *Act* as any natural watercourse or source of water supply, whether usually containing water or not, and includes groundwater and any lake, river, spring, swamp, creek, ravine or gulch.

The following types of stream crossing also require approval under the *Water Act*:

- bridges which require abutments, piers, earth fill approaches or riprap below the normal high water mark of the stream, or which require alteration of the channel configuration or alignment,
- culverts with a diameter greater than 2 metres,
- culverts with a fill height of 3 metres or greater over the culvert,
- culverts on streams which drain a basin area greater than 10 km^2, and
- culverts which require alteration of the channel configuration or alignment for installation.

Inquiries regarding water licences and approvals should be directed to a regional office of the Water Management Branch (see Appendix I).

Community Watersheds

The Ministry of Energy, Mines and Petroleum Resources is committed to integrated watershed management planning and the protection of water quality and water intake facilities in community watersheds. Mineral exploration in community watersheds is coordinated with the Water Management Branch and other government agencies to ensure high quality community water supplies are maintained while providing opportunities for mineral resource development which do not affect these supplies.

Mineral exploration activities in environmentally sensitive community watersheds may be subject to special conditions and operational constraints, including:

- operator participation in Integrated Watershed Management Plans,
- coordinated access road planning processes,
- flexible scheduling of work to avoid times that are critical to water quality,
- total reclamation of all surface disturbances immediately following each work program, and
- site specific reclamation security deposits.

Further information on community watersheds is provided in the B.C. Environment publication, "Guidelines for Watershed Management of Crown Lands Used as Community Water Supplies", available from regional offices of the Water Management Branch.

MINISTRY OF FORESTS

Construction of mining access roads in Provincial Forests, cutting of timber and slash hazard abatement are all controlled through permits and licences under the *Forest Act*. Depending on the location and nature of the exploration program proposed, any of the following may be required:

- **Special Use Permit (SUP)** - to occupy Provincial Forest land outside of the mineral tenure for mining access roads.
- **Road Permit** - to construct an access road through Provincial Forest land under a SUP, but does not apply to access roads on the mineral tenure.
- **Road Use Permit** - to use a Forest Service Road for other than light traffic.
- **Free Use Permit** - to cut timber to be used directly in exploration activities.
- **Licence to Cut** - to clear timber from areas to be used in the exploration program, or to clear timber under a SUP.
- **Timber Sale Licence** - to clear timber where the Ministry of Forests determines that there is a market demand for the timber.
- **Burning Permit** - to start any fire in a forest.

Processing of applications for *Forest Act* permits and licences may take up to 90 days. For further information, contact the regional Ministry of Forests office (see Appendix I) or any Forest District office.

Forest Wilderness Areas

Under the *Forest Act*, the Ministry of Forests has responsibility for the designation and management of forest wilderness areas. Mineral exploration and development is not prohibited in designated forest wilderness areas, and is managed under existing regulations and guidelines.

A Ministry of Forests permit is required to land a helicopter in a designated forest wilderness area, except under emergency circumstances.

All mining roads within designated forest wilderness areas will be closed to public traffic, and subject to reclamation in accordance with these guidelines.

The Ministry of Energy, Mines and Petroleum Recources recognizes the need to carefully manage mineral exploration in forest wilderness areas, and may therefore apply additional special conditions and detailed reclamation guidelines where required through coordination with the Ministry of Forests.

DEPARTMENT OF FISHERIES AND OCEANS

The federal Department of Fisheries and Oceans has responsibility under the federal *Fisheries Act* for protection of fisheries sensitive areas. In order to identify these sensitive areas and design work programs to protect the fisheries resource, contact a District Office or Habitat Management Office (see Appendix I) prior to commencing any work in or about a watercourse.

MINISTRY OF HEALTH

The Ministry of Health has responsibility under the *Health Act* for issuing the following permits and approvals on a mineral exploration property:

Sewage Disposal

Pursuant to the *Sewage Disposal Regulations*, a permit is required from the local Ministry of Health authority prior to any installation of an on-site sewage system having a discharge rate of 22.3 cubic metres per day (5000 gal/day) or less. A discharge rate in excess of 22.3 metres per day requires the approval of B.C. Environment.

Drinking Water

Ministry of Health approval is required for the source and waterworks system prior to the installation of works.

Food Services

Food service facilities at an exploration camp require a permit under the *Food Premises Regulations*. In general, mining camps that are occupied by more than 5 persons or that are established for a period of more than 7 days come within the meaning of these regulations.

MINISTRY OF TOURISM AND MINISTRY RESPONSIBLE FOR CULTURE - ARCHAEOLOGY BRANCH

Responsibility for the protection and conservation of archaeological sites rests with the Archaeology Branch, who review the **Notice of Work on a Mineral Property** on referral by the Regional Mining Engineer. Under the *Heritage Conservation Act*, a permit is required to conduct

any work that would alter an archaeological site or provincial heritage site. In some areas, it may be necessary to conduct an archaeological impact assessment in advance of mineral exploration activities.

2.4 RIGHT OF ENTRY ON PRIVATE LAND

Under the *Mineral Tenure Act*, the right to enter mineral lands for purposes of exploration extends to private land with the exception of cultivated land, orchard land and those areas occupied by dwellings or other buildings. This right of entry may not be exercised, however, for the purpose of commencing mineral exploration activities involving surface disturbance by mechanical means, without first giving notice to the owner of every land surface affected.

The owner of private land is entitled to compensation for any loss or damage caused by mineral exploration work. Agreements with respect to right of entry, use of the land and compensation are normally reached through negotiation between the operator and the land owner. If any dispute arises, it must be referred to a Gold Commissioner (see Appendix I). A Mediation and Arbitration Board has been established as the final authority for settling matters of dispute, and may make orders or rulings respecting entry and use of private land for mineral exploration purposes.

III.

WORK GUIDELINES

All mineral exploration permits are issued subject to these "Guidelines for Mineral Exploration".

Based upon recommendations from other agencies, the Regional Mining Engineer may issue a permit with special conditions and may place added restrictions on proposed exploration activities in order to minimize impacts in environmentally sensitive areas.

3.1 CLEARING AND SLASH HAZARD ABATEMENT

Clearing of forests and slash disposal are regulated by the Ministry of Forests. These activities must be carried out in compliance with the Fire Prevention Regulation. The appropriate *Forest Act* permits and licences (see Section 2.3) must be obtained from the local Ministry of Forests office prior to any clearing. Crown timber cut under a Licence to Cut or Timber Sale Licence is subject to stumpage, calculated in accordance with the Ministry of Forests Appraisal Manual.

In recreation areas, any clearing of forests must also be approved by the Regional Director of Parks prior to commencement of work.

SAFETY NOTE

All persons operating chainsaws must wear leg protective devices approved by the Workers' Compensation Board.

CLEARING

Pre-logging of road rights-of-way is encouraged and, in some areas, may be required. In this procedure merchantable timber, usually in lengths greater than 2.5 metres with a top diameter greater than 10 centimetres, is decked and later sold by the Ministry of Forests. Pre-logging has been found to yield a more stable roadbed and, in many cases, has substantially offset slash abatement costs.

On main roads, all trees must be felled onto the right-of-way and those trees not salvaged must be totally disposed of by burning or burying.

On temporary trails and on drilling, trenching, portal or other similar sites, trees pushed over may usually be disposed of by lopping and scattering. In no case shall trees be left leaning into marginal timber. Total disposal is required within 400 metres of where any temporary road crosses a permanent watercourse or permanent road, and may also be prescribed in other areas where deemed necessary by the Ministry of Forests for effective forest management.

HAZARD ABATEMENT

Pursuant to section 117 of the *Forest Act*, an order to abate slash hazard will be issued in all cases where timber is cut, and will generally call for slash treatments similar to those discussed below.

Burning

All slash burning during the fire season, normally April 15 to October 15, requires a permit issued by the local Ministry of Forests office. In most forest regions, burning of industrial or machine-piled slash requires a permit at all times of the year. Periods of high fire hazard may result in the cancellation of burning permits until more favorable conditions prevail.

Material under 20 centimetres in diameter should be round-piled not less than 5 metres away from the forest margin and burned when weather conditions permit. Larger material may be burned in a similar manner or, if this is not possible, bucked so that it is in close contact with the ground and windrowed at least 5 metres from the forest margin. Unburned stumps may be scattered singly along the right-of-way, along with any charred material left after burning. In no case may debris be left bunched or in piles.

Burying

Burying is an acceptable method of slash disposal in most situations but requires a high level of supervision to ensure a satisfactory job. Approval of the District Forest Manager is required for slash burial.

Disposal areas must be cleared and a pit constructed to receive slash. Material to be buried must be cut into lengths of less than 4 metres and compacted within the pit so that nothing protrudes above ground level. Compacted piles should then be covered by at least 1 metre of mineral soil, then seeded and fertilized.

Lopping and Scattering

On winter roads or temporary access roads less than 10 metres wide, and on drill sites, trenches and portals less than 0.2 ha in size, slash may be disposed of by lopping and scattering. When this method is used, all trees felled must be limbed and the branches scattered. Boles of trees must be cut from the stump at the root crown and bucked so that they lie in close contact with the ground.

On larger clearings, total disposal of slash will normally be required.

Chipping

Chippers have been used successfully for the disposal of slash less than 25 centimetres in diameter. When used in conjunction with pre-logging, the requirements for burning or burying are greatly reduced.

3.2 ACCESS ROADS

Construction of access roads, both on and off mineral claims, can have a major impact on other resource values. Special care must therefore be taken to design and construct exploration roads which minimize land disturbance.

Access road proposals on large exploration programs or in environmentally sensitive areas are normally subject to detailed inter-agency review or other coordinated access road planning processes. Special design, construction and reclamation provisions may be prescribed in these cases. In the case of preliminary, reconnaissance programs in sensitive areas, exploration may be restricted to air access and helicopter-supported activities.

The following sections outline a number of guidelines for reducing the environmental impacts of exploration access roads.

ROAD DESIGN

Use existing roads whenever possible. Build the narrowest road possible consistent with safety and traffic needs. Plan for minimum permanent road length through the use of main access roads and secondary tote roads. In some areas, road location and design may be subject to coordinated access plans or other access management planning processes.

Avoid sensitive areas. Areas may be sensitive because of conflicts with other resources or because of problems in construction and reclamation. Some examples of sensitive areas are:

- wildlife winter ranges (southwest-facing grassy or shrubby slopes), saltlicks,
- highly erodible areas, i.e. fine textured soils, steep slopes (see Table 1),
- streams, lakes, marshes, bogs and riparian areas,
- alpine areas,
- recreation areas, forest wilderness areas, community watersheds and wildlife management areas, and
- areas directly visible from recreation areas.

TABLE 1. GUIDE FOR ASSESSING SOIL EROSION HAZARD

	SLOPE				
TEXTURE	0—3° 0—5%	3—5° 5—9%	5—17° 9—30%	17—31° 30—60%	31° 60%
Fine	Moderate	High	High	High	High
Fine to medium	Moderate	Moderate	High	High	High
Medium	Low	Low	Moderate	High	High
Medium to coarse	Low	Low	Moderate	Moderate	High
Coarse	Low	Low	Low	Moderate	High

Locate roads to fit the topography, making use of natural benches, ridgetops and flatter slopes to avoid extensive cuts and fills. This will not only reduce construction costs but will avoid the possibility of unstable embankments.

Locate roads such that no portion of the road or road embankment lies within 50 metres of a lake or stream, except at stream crossings. The permission of an inspector is required to locate a road within this limit.

Roads should be designed to keep grades as low as possible. Maximum grades of 8 to 10 percent are desirable, although short pitches of up to 15 percent can be accepted if necessary. Table 2 presents some approximations regarding slopes.

TABLE 2. SOME APPROXIMATIONS REGARDING SLOPES

REMARKS	GRADIENT		
	per cent	*degrees*	*horizontal:vertical*
Maximum for main haulage	8	5	11:1
Short pitches	10	6	10:1
Approximate two-wheel drive maximum	15	9	6:1
Maximum soil slope for vegetation	50	26	2:1
Angle of repose earth fill	67	34	1.5:1
Angle of repose loose angular rock	80	39	1.25:1

ROAD CONSTRUCTION

Proposed access routes must be inspected on foot and flagged at least 2 kilometres in advance of any construction equipment. Site specific relocations may then be made to avoid problem areas.

Clear only the minimum area needed, having due regard for slash disposal and ditching requirements. Before clearing borrow pits, test the area to ensure that adequate quantities exist. Obtain road gravel from approved locations only.

Where construction must take place in unstable soils or adjacent to major streams, try to take advantage of periods of dry weather. Suspend any road building operations causing erosion or siltation, especially during periods of heavy rainfall. It is recommended that backhoes be used to build roads on easily erodible or poorly drained soils.

In level terrain such as alpine tundra where cuts and fills are not required, road construction should be minimized. Tracked vehicles should be used for access to avoid road construction, however road alignments must be clearly flagged to ensure that travel is confined to selected routes. This is also important for safety during winter white-outs.

Road embankments should be stabilized in accordance with the following guidelines:

- Remove roots, vegetation and large rocks.
- Pulverize large lumps of soil before compaction.
- Control groundwater to prevent saturation of fill material, using pipe drains or filter blankets if necessary.
- Avoid the high water zones of streams, and protect embankments from erosion using riprap where necessary.
- Do not sidecast material onto unstable slopes or into any watercourse.
- Construct fill in lifts to achieve maximum compaction.
- Reduce the slope angle of cut banks, round the tops of cut slopes and fall any trees that may become undercut by erosion.
- Avoid any disturbance of the toes of cut slopes during road maintenance.

- Leave a top dressing of slash on embankments, seed and/or mulch immediately to establish vegetation or, if necessary, construct protective works such as terraces, cribs or retaining walls.

Berms are to be left on roads that traverse steep slopes, however they must be breached at appropriate intervals so that runoff cannot become concentrated on the road surface.

Road width must be minimized when traversing steep slopes, and in some cases endhauling may be prescribed. Full bench construction, which will require specialized equipment such as loaders, backhoes and dumptrucks, is mandatory on slopes exceeding the angle of repose (see Table 2).

WINTER CONSTRUCTION

Road construction may be permitted during winter months under certain conditions. The main deterrents to winter construction are excessive snow depths, extreme groundfrost conditions and steep topography. Given favorable conditions winter construction may prove less damaging than summer construction, particularly in areas where high groundwater levels can result in serious erosion and stability problems during summer months. Properly constructed ditches and culvert crossings will control groundwater and surface runoff during spring breakup, resulting in a more stable roadbed.

In forested areas, sufficient right-of-way must be cleared to facilitate the removal of snow from the proposed road grade. Since this will require more clearing than normally recommended for temporary roads, winter construction should only be considered for permanent main roads.

Guidelines for winter construction of roads:

- Avoid steep grades and side slopes.
- Prevent snow and ice from entering fills.
- Construct elevated grade in known wet areas.
- Surface the roadway with rock or shale in areas of fine-textured soils.
- Install culverts and ditches as construction progresses.

SURFACE DRAINAGE

Drainage design is the most important single element of road layout. Time spent before construction in identifying the drainage requirements of each section of road, and in ensuring that the appropriate equipment and materials are available for the job, will be fully compensated by savings in construction and maintenance costs.

Design

Drainage systems should be designed on a site specific basis and must be capable of carrying the maximum expected runoff, while maintaining natural drainage patterns as closely as possible.

Particular attention must be paid to areas of rapid runoff, such as:

- areas of steep slopes,
- areas of shallow soils,

- areas of impervious fine-textured soils,
- non-forested areas, and
- south and west facing slopes where snow melt is rapid.

Planning

Install a sufficient number of culverts large enough to accommodate anticipated high water flows and sediment loads.

The location, size and type of all required culverts should be shown on the location plan given to the operators.

Drainage of Permanent Roads

On frequently used or permanent roads, or on any road in highly erodible soils, a system of ditches and culverts must be installed keeping in mind the following criteria:

- Ditches and culverts must be large enough to accommodate the 100 year return flood flow. A drainage system that cannot carry the maximum runoff is worse than no system at all because the water is concentrated in one channel and can cause serious erosion. Culverts must be installed at frequent intervals to prevent concentrated discharges onto the lower slopes. Culverts should be located to avoid spilling onto unstable slopes.
- Catch basins should be installed above culvert inlets, with ditch blocks placed below the basins to direct water through the culvert (see Figure 1). Drainage ways should be cleared of all construction debris and fill material. Riprap placed on the ditch block will minimize erosion and washout. Culverts should be marked with large painted stakes so that they can be easily located for regular maintenance.
- Road surfaces should be crowned so that water flows into the ditches rather than collecting on the road. On long, steep hills the road grade should be rolled to discourage water flow along the road surface.
- Run-off should not be collected and discharged off the end of roads or switchbacks.
- Culverts should be skewed to the same degree as water bars and should have a minimum 1 percent slope. Under conditions of high debris loads and in areas of unstable deep fills, culverts should be installed along the natural slope (see Figure 1). Although this procedure requires a long culvert that must be installed before any fill is placed, it improves the self-cleaning capability of the culvert and avoids discharge onto the fill slope.
- Culvert discharges should be directed onto stable slopes. Rocks or other energy dissipating materials should be placed below the outlet to prevent erosion (see Figure 1). Wherever possible, take advantage of low fills to release water. If drainage must be discharged over a deep fill then downspouts made from half-culverts should be placed on the fill slope. Route all roadside drainage into silt traps on the forest floor so that sediments will settle out before the water reaches a stream. Slash from the road right-of-way may be windrowed along the toe of the fill slope to assist in the filtering process.

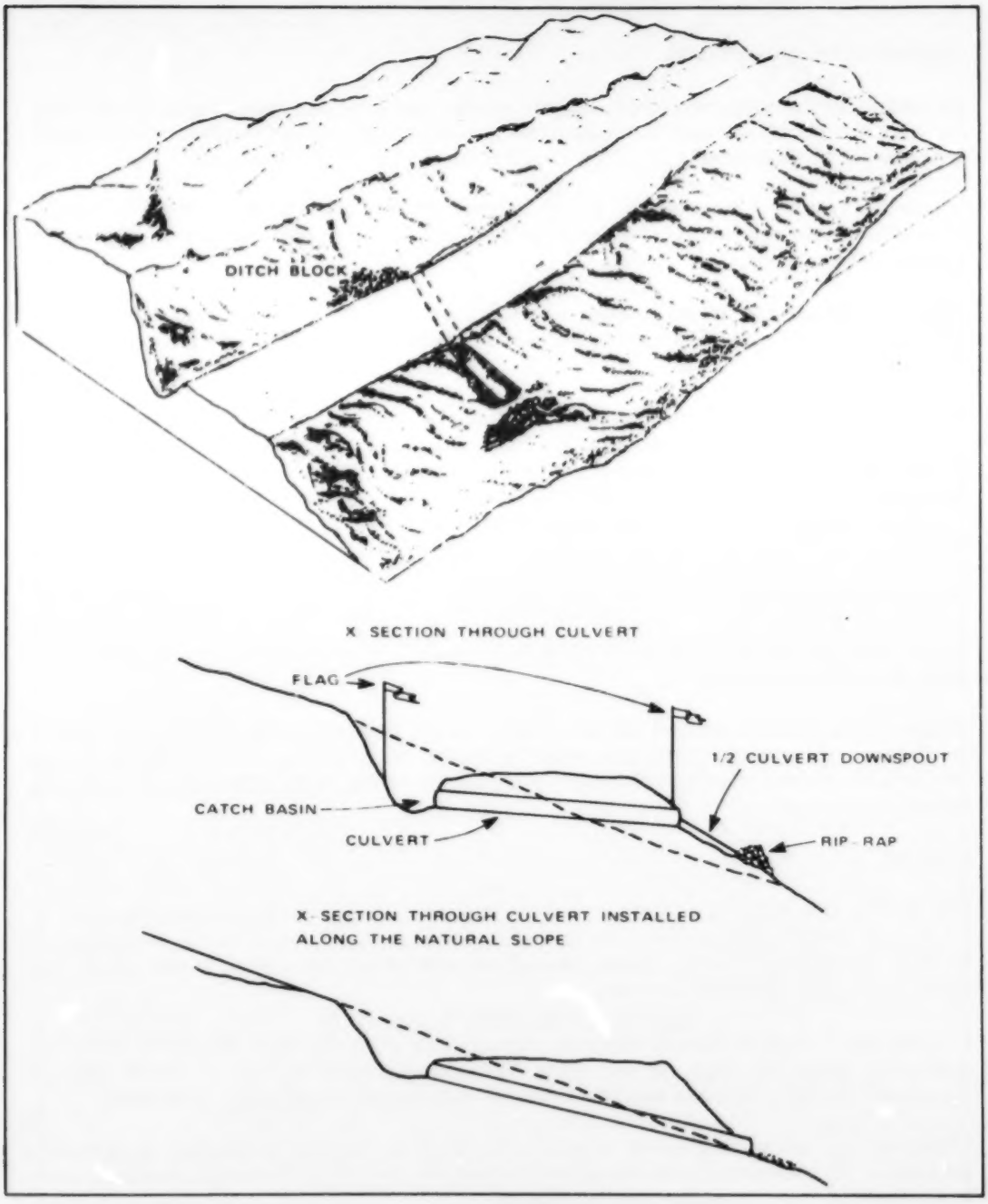


FIGURE 1

CULVERT INSTALLATION ON PERMANENT ROADS

- Special care must be taken to divert drainage away from borrow pits and waste dump areas.

Drainage of Temporary Roads

On seldom used or temporary roads, a system of dips and water bars may be used for drainage and erosion control (see Figure 2). These must be close enough together that the amount of water collected can be easily diverted.

Appropriate spacing of water bars on various slopes in different soil types is presented in Figure 2. These intervals are approximate and should be modified to avoid diverting water onto deep fills or unstable natural slopes.

Water bars should be skewed to allow water to drain downhill across the road. As an extra protective measure water bars must be installed at the end of each field season along the entire road network.

In areas that have a low erosion hazard and where vehicle speed will be less than 30 kilometres per hour (20 mph) roads may be outsloped (see Figure 3). Outsloping allows runoff to drain directly across the road surface and avoids the necessity of constructing and maintaining a system of ditches and culverts, however this method should be used with extreme caution in difficult areas. Wherever slippery conditions are anticipated due to mud or ice conditions, outsloping should be avoided.

STREAM CROSSINGS

Stream crossings can affect fish by blocking fish migration routes, destroying stream habitat and silting downstream channels.

Different types of crossings have different impacts on fish populations and the correct choice of structure can therefore go a long way toward protection of the fishery resource. Any work that results in the harmful alteration, disruption or destruction of fish habitat is an offence under the federal *Fisheries Act*.

Planning

As in all other phases of the exploration program, stream crossings must be carefully considered in the planning stage so that problems can be identified and solved before they occur. Regardless of the type of crossing proposed, construction plans must ensure that activity in and around the stream is kept to an absolute minimum.

For proposed bridges or culverts requiring prior approval under the *Water Act* (see section 2.3), application should be made to the Water Management Branch at least 1 month prior to construction, to allow adequate lead time for review and issuance of approvals.

Additional information on planning of stream crossings is provided in the B.C. Environment publication, "Environmental Objectives and Procedures for Water Crossings", available from regional offices of the Water Management Branch.

General

Any construction in and around a stream channel will require careful supervision to ensure that debris and soil are not inadvertently pushed into the water. It has been shown that the cost of

extra supervision during construction in sensitive areas is strongly offset by the increased efficiency of the work and the prevention of environmental damage. Seasonal restrictions may apply to planned instream work.

INTERVALS FOR WATER BARS

Slope Gradient	Erodible Soils (Silts and Clays)	Normal Soils (Loams)	Rocky Soils (Sand and Gravel)
	Metres	Metres	Metres
Under 5% (3°)	45	60	nil
5–10% (3–6°)	35	45	60
Over 10% (6°)	15	30	45

FIGURE 2

CONSTRUCTION AND LAYOUT OF WATER BARS

Upon completion of a crossing structure, all debris must be removed from below the high water mark since it may otherwise enter the stream during heavy runoff. Clogging with debris is one of the major causes of crossing failure. Any bridge abutments or fill slopes that are constructed below high water must be stabilized with riprap to prevent erosion.

Water from small or intermittent streams must not be diverted along roadside ditches.

All streams, whether flowing continually or intermittently, should be crossed using either bridges, culverts or fords as discussed below.

Bridges

Bridge crossings must be used on any streams that support fish populations or on any streams with a channel width greater than 3 metres. Properly constructed bridges do not impair stream flow characteristics or stream habitat.

A plan for a simple log bridge suitable for crossing a small stream is given in Figure 4. This bridge can be built largely of local materials, perhaps utilizing trees felled during road clearing. A propylene or unwoven geotextile filter blanket must, however, be installed on earth covered bridge decks to prevent soil from entering the stream.

Figure 5 presents a log stringer bridge plan based on Ministry of Forests standards for use on larger channels. Permanent bridges should be professionally engineered and built by personnel familiar with bridge construction.

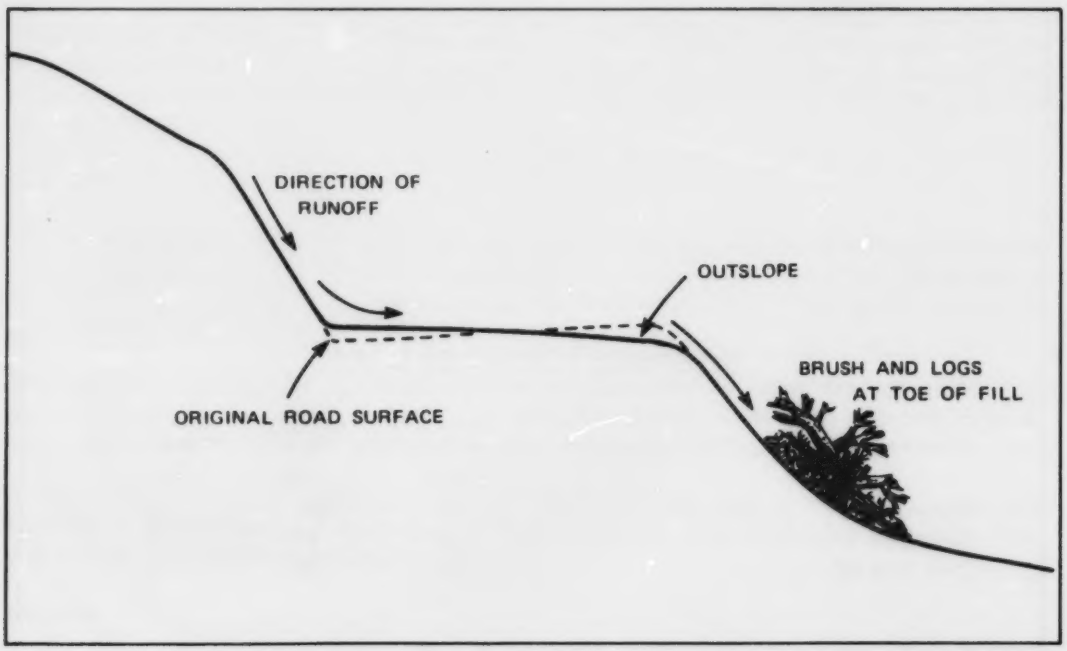
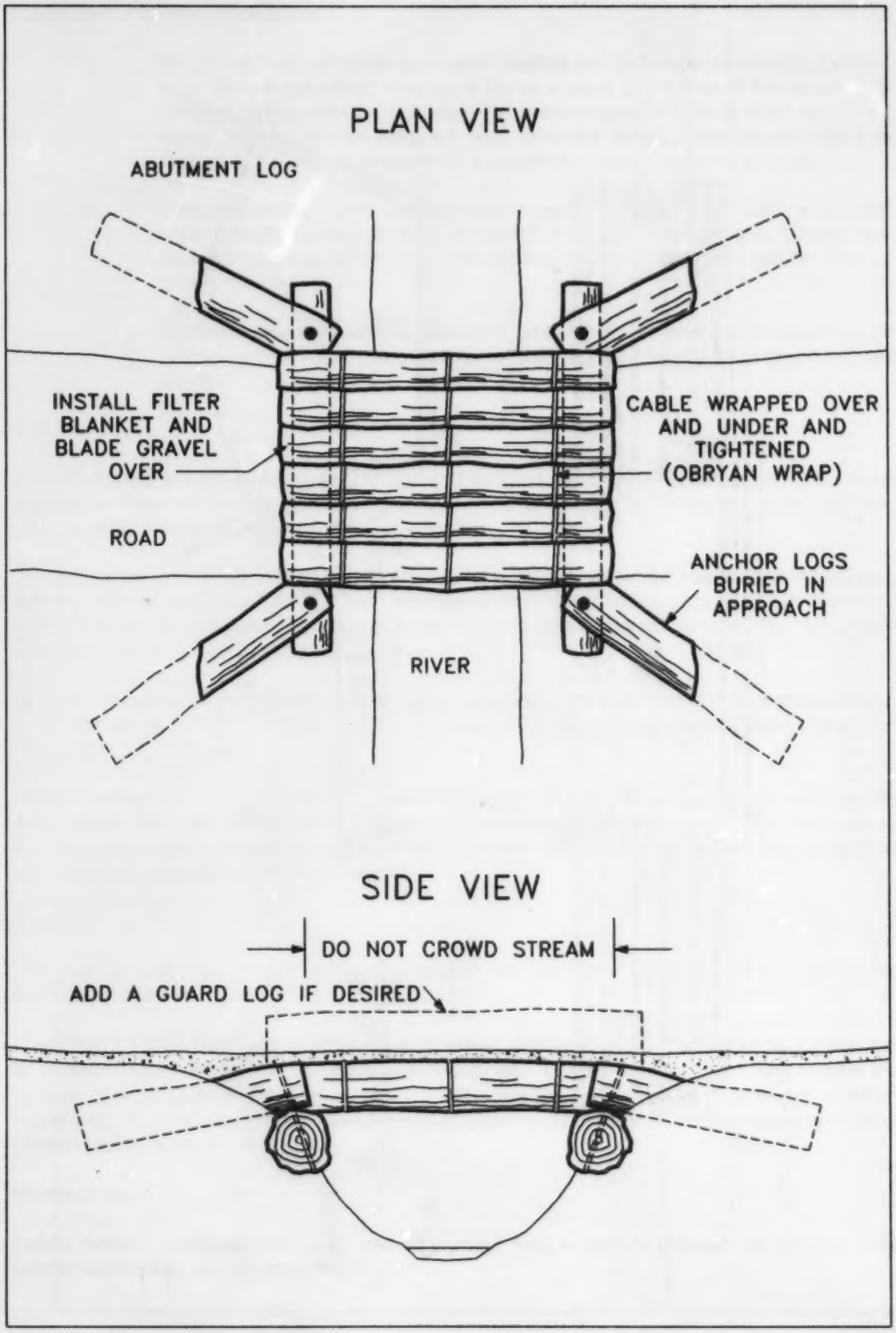


FIGURE 3

CROSS-SECTION OF AN OUTSLOPED ROAD


PLAN VIEW
ABUTMENT LOG
INSTALL FILTER BLANKET AND BLADE GRAVEL OVER
CABLE WRAPPED OVER AND UNDER AND TIGHTENED (OBRYAN WRAP)
ROAD
ANCHOR LOGS BURIED IN APPROACH
RIVER
SIDE VIEW
DO NOT CROWD STREAM
ADD A GUARD LOG IF DESIRED

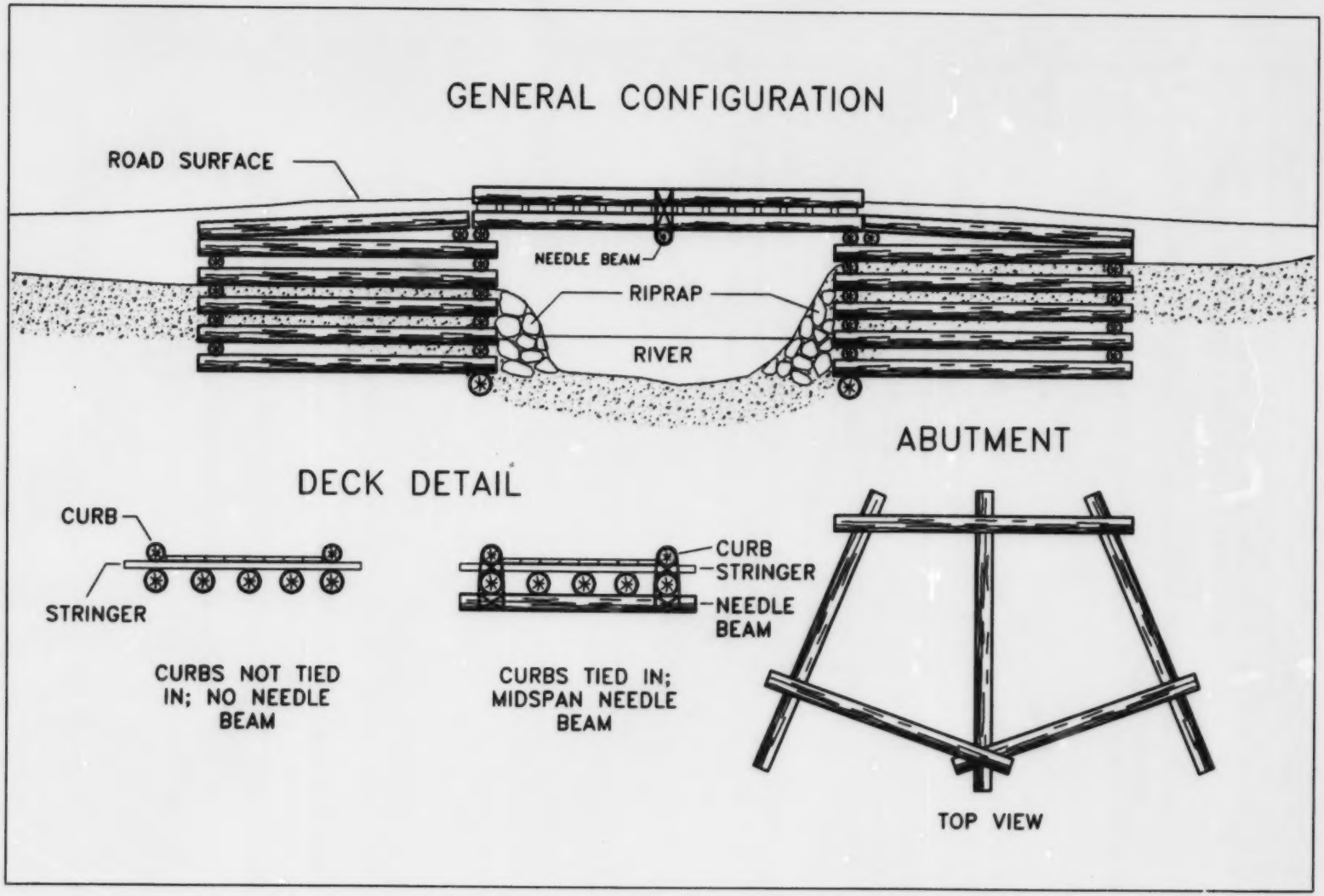


FIGURE 5

A SIMPLE STRINGER BRIDGE FOR USE ON LARGER STREAMS

Guidelines for bridge construction:

- Rough-notch all crib joints to improve seating and to reduce the spacing between logs. Ensure the bottom crib log is buried at least to the level of the stream bed. Some blocking may be necessary to prevent backfill from spilling out during floods, as loss of crib filling will lead to bridge failure. Use coarse gravel or cobbles to fill cribs as this material is less likely to erode between the logs.

- Construct bridge spans that are long enough to ensure a full span of the high water channel as well as to provide solid abutment footing. Many failures have occurred because of erosion of abutments that were extended too far into the stream channel.

- Construct bridges so that water will be able to flow around the structure via old backwater channels in case of a large flood. Do not raise the road grade in these areas.

Culverts

Even when installed in the best possible manner culverts disrupt stream habitat and increase water velocity, causing restriction of fish passage. Culvert crossings are, therefore, recommended only for small streams that do not support fish populations.

On streams not specifically designated as fish habitat but where there is a possibility that fish exist, culverts may be used provided that their installation does not cause restriction to fish migration. Culverts must be adequately sized, and installed deep enough in the stream bed, to provide sufficient depth of water for fish passage.

Hanging outfalls must be avoided. These may be caused by improper installation of the culvert or by erosion at the outlet. The latter may be minimized by protecting the channel below the culvert with riprap.

Under freezing conditions culverts may become plugged with ice. Iced up culverts usually thaw more slowly than the adjacent stream and may therefore cause blockages. This can lead to flooding, road washouts and disruption of fish passage. A maintenance system for ice removal may be required under freezing conditions.

Fords

The use of fords as stream crossings requires the approval of B.C. Environment, Water Management Branch.

Fords may be approved only on channels with coarse, cobbly beds and they must be constructed to minimize sediment release during vehicle crossings. Construction of fords may require the removal of large boulders and debris, but in no case may the stream bed be disturbed or modified in any way. If a ford requires constant maintenance to remain passable, then an alternate type of crossing must be used.

Debris Bridges

Debris bridges, consisting of slash and fill pushed into a stream channel for temporary or permanent access, are not permitted.

3.3 DRILLING

The impact of drilling is easily minimized by proper planning and good work practices.

Although the location of drill holes is dictated by geological, geophysical or geochemical anomalies, slight relocations are often possible to avoid problem areas. Do not locate drill sites on unstable slopes, steep terrain or wet areas as this will significantly increase construction and reclamation difficulties. Drill holes shall not be located within 50 metres of streams or lakes except with the approval of an inspector. Use the smallest possible drill pad area consistent with safe working practices. Trees should be felled and bucked according to slashing guidelines.

If stripping or levelling of a drill site area is required for safe location of a drill pad, topsoil and overburden must be removed and stockpiled for use in reclamation when the drill site is abandoned.

An adequate closed circuit facility must be provided for drilling mud and flocculating agents. Drill sludge shall not be allowed to enter streams or lakes, or to run uncontrolled. A small well-constructed settling pond or sump a short distance downslope from the drill is usually adequate.

Water supply pumps must be located above the high water line of any watercourse, and be adequately bermed to prevent fuel spills into the stream (see section 2.3, fuel storage and spill reporting). Ensure solid footing under the pump and fuel containers.

At the completion of drilling, the site should be resloped and revegetated according to the Reclamation Guidelines (Chapter IV).

All surface drill holes that encounter uranium mineralization at a grade of 0.05% by weight or greater or thorium at a grade of 0.15% by weight or greater at a designated site must be sealed by completely filling with concrete in accordance with Part 11, Schedule C of the *Health, Safety and Reclamation Code*.

If, during drilling operations at a designated site any groundwater issues from a borehole, the flow of water must be stopped or contained in a containment structure until the water has been sampled, analyzed and found to be acceptable in accordance with Schedules C and D of the *Code*.

If, during drilling operations at other than a designated site any groundwater is released to the surface, the drill hole location must be immediately reported to an inspector. If, in the opinion of the inspector, the flowing hole is creating an environmental or health hazard the hole shall be cemented or otherwise plugged to prevent the flow of water.

Helicopter accessed drilling may be prescribed in environmentally sensitive areas.

3.4 TRENCHING

Trenching has, in the past, caused severe disturbance in many areas.

For all trenching programs, careful planning is necessary to identify trench sites that will give the greatest amount of information with the smallest amount of disturbance.

In all cases, trenches should be located at right angles to the strike on slopes greater than 26 degrees (2 horizontal : 1 vertical).

No water may be allowed to escape from a trench or other excavation at a designated site until samples of the water have been taken, analyzed and found to be acceptable in accordance with Part 11, Schedules C and D of the *Health, Safety and Reclamation Code*.

Overburden to root depth must be segregated for use in resloping. Under no circumstances should material be cast downhill. After geological work has been completed and before the end of the season, the trench must be reclaimed and revegetated according to the Reclamation Guidelines (Chapter IV).

The three most common methods of trenching are discussed below.

HAND TRENCHING

The major advantage of hand trenching is that road access to the trench site is not necessary. This greatly decreases the disturbed area and allows trenching on sites that are not otherwise accessible. Because the trench itself is small and disturbance is limited, requirements for backfilling and reclamation are greatly reduced.

BACKHOE TRENCHING

The backhoe was designed as a trenching tool.

Backhoe trenches are usually quite narrow and thus cause little disturbance. Topsoil and overburden are easily removed and stockpiled adjacent to the trench for use in resloping. A backhoe, a small dozer or a skidder can be used for backfilling and site preparation.

Backhoe trenches greater than 1.5 metres deep must have their walls sloped back or be provided with adequate structural support to prevent collapse if it is necessary for a person to enter the trench for mapping or sampling.

BULLDOZER TRENCHING

Bulldozer trenching is not permitted except with the approval of the Regional Mining Engineer.

3.5 UNDERGROUND DEVELOPMENT

Surface disturbances associated with underground development can present problems in erosion control, dump stability, acid drainage and reclamation.

The following general guidelines shall be followed:

- Strip topsoil and overburden from the portal site, stockpile separately and use to cover disturbances upon completion.
- Leave a minimum of 50 metres between surface disturbances and any lake or stream.
- Provide for adequate diversion of surface drainage around the portal site and onto stable areas adjacent to disturbances.

- Ensure that waste rock is not placed in any watercourse.

- Portals must be closed to the satisfaction of the District Inspector of Mines upon completion of work or abandonment of the work site.

- No water from an underground exploration area at a designated site may be allowed to escape into surface waters until samples of the water have been analyzed and found to be acceptable in accordance with Part 11, Schedules C and D of the *Health, Safety and Reclamation Code*.

3.6 ACID MINE DRAINAGE

During exploration, a preliminary assessment of acid generation potential should be carried out by the project geologist. This can be done by mapping the geology of the site and gathering all available acid generation data on the potential ore zone and host rocks, such as the type and content of sulphide minerals and carbonates. Comparisons should also be made with nearby minesites where the potential for acid mine drainage has already been demonstrated.

Where exploration activities have progressed to the stage where underground development or significant surface rock disturbance is proposed as the next step, acid generation testwork must be conducted and the results of the testwork submitted to the Regional Mining Engineer and B.C. Environment prior to commencement of work. Acid-base accounting analyses must be carried out on at least three representative samples of all geologic units to determine the relative quantities of acid generating minerals and acid consuming minerals in the ore and host rock zones.

Wherever the potential for acid generation is identified, a plan for the disposal of acid generating materials and the prevention of acid mine drainage must be submitted to the Regional Engineer for review by the Regional Mine Development Review Committee. In cases where satisfactory prevention measures cannot be assured, additional reclamation security will be required to reflect the actual cost of perpetual control of acid mine drainage, taking into account the risk to the environment.

IV.

RECLAMATION GUIDELINES

The following guidelines are minimum requirements and, depending on the nature of the exploration activity and the environmental sensitivity of the area, increased standards may be required as a condition of the reclamation permit.

4.1 CAMP SITES

Exploration camps which are to be abandoned shall be dismantled and removed at the end of operations. All refuse shall be burned and buried or removed, and all pits shall be backfilled. The site shall be ripped, if necessary to break surface compaction, and revegetated.

Camps which are to be maintained for future use shall be left in a clean and tidy condition at the end of operations. All refuse shall be burned, buried or removed and all pits shall be backfilled. Any camps which remain inactive for three years will be considered to be abandoned, and must be removed and the site fully reclaimed as described above.

4.2 DRILL CORE STORAGE

Drill core shall be removed from the property or otherwise disposed of upon abandonment, unless specifically exempted by the Regional Mining Engineer. Any drill core left on the site must be stored in a secure location and the costs of removal provided for under a reclamation permit.

4.3 FUEL DRUMS

All empty fuel or oil drums shall be removed from the property at the end of operations.

Fuel or oil left on site for future work programs requires the specific approval of the Regional Mining Engineer, and the removal costs must be provided for in the reclamation security. Fuel drums left on site must be stored in a central, secure location, away from watercourses.

4.4 TRENCHES, DRILL SITES AND MAJOR EXCAVATIONS

All trenches, drill sites and major excavations shall be backfilled and recontoured as nearly as possible to the previously existing slope. Stockpiled topsoil and overburden shall be spread over the site and the entire site shall be revegetated. Surface drainage shall be diverted around disturbed areas. Where this is not possible, erodible material must be protected by riprapping or some other acceptable means.

In addition, where exploration at a designated site results in any exposed surfaces or excavated materials including drill core, cuttings or rock samples that emit radiation above the baseline level,

the exposed surfaces or materials shall, if required by the Regional Engineer, be covered with a suitable material in accordance with Part 11, Schedule C of the *Health, Safety and Reclamation Code*.

4.5 UNDERGROUND PORTALS AND WASTE DUMPS

Portal areas and waste rock dumps shall be recontoured, dressed with available stockpiled topsoil and revegetated. Any drainage from the portal shall be directed away from unstable slopes and onto the forest floor. Portals shall be backfilled or otherwise sealed to the satisfaction of the Regional Engineer.

If acid generation tests (see Section 3.6) indicate a potential for acid mine drainage, special waste rock disposal and reclamation treatments may be prescribed.

4.6 ROADS

It is important to identify those roads that can be abandoned and those roads that are necessary for future exploration. Roads that will not be used the following field season should be treated as abandoned. Some portions of the road system may be required by the Ministry of Forests for permanent fire access, therefore it is in the operator's interest to contact the Ministry of Forests in this regard.

PERMANENT ROADS

Roads that are to be retained for permanent access shall be maintained annually. Roadsides and embankment slopes shall be revegetated. All drainage structures should be inspected and cleaned on a regular basis, especially after the spring run-off period and periods of heavy rainfall.

ABANDONED ROADS

All abandoned roads must have a system of permanent erosion control, with erosion bars placed at frequent intervals to ensure stability (see Figure 2). All culverts and bridges shall be removed and stream banks shall be restored as nearly as possible to their original condition. Abandonment activities must be undertaken in a manner that minimizes sedimentation of watercourses.

The requirement to recontour roads will vary according to their location and environmental sensitivity as summarized below:

- Roads on environmentally sensitive areas will require complete recontouring.
- Roads in alpine and high subalpine areas will require the pulling back of berms containing topsoil material.
- Other roads will only require recontouring where necessary for erosion control, although drier sites would also benefit from a dressing of topsoil.

All abandoned roads shall be ripped, if necessary to break surface compaction, and revegetated. Abandoned roads should be ditched at their junction with permanent roads so as to prevent vehicle access.

4.7 REVEGETATION METHODS

This section outlines revegetation treatments for the normal situation. Recommended seed mixtures are based on the best available knowledge at this time. There is no guarantee that these treatments will be 100 percent effective.

All disturbed areas must be stabilized and revegetated before the reclamation security can be returned. In all instances, revegetation treatments require applications of both seed and fertilizer. Where necessary the operator may be required to reseed or refertilize poorly vegetated sites.

The introduction of non-native plant species to recreation areas is of concern to B.C. Parks. Specific revegetation proposals for recreation areas may therefore be subject to restrictions on the use of certain species.

METHODS OF SEED AND FERTILIZER APPLICATION

Broadcasting is the usual method for applying seed and fertilizer. Seed may be broadcast by hand, by hand-held cyclone seeders, by spreaders mounted on all-terrain vehicles or by spreaders mounted on helicopters or aircraft.

Revegetation success is increased if, following broadcasting, the seed is buried by a thin layer of soil. This may be accomplished by running a tracked vehicle over the seeded area or by harrowing the area. A design of a simple harrow is presented in Appendix F.

Hydroseeding is a technique whereby a slurry composed of seed, fertilizer, mulch (or other soil stabilizer) and water is pumped through a nozzle and sprayed over the ground.

Agricultural seed drills can also be used for seed and fertilizer applications. They are limited to well prepared, level areas.

RECOMMENDED SEED MIXTURES

Revegetation prescriptions are given for all areas of British Columbia in Appendices G and H. To find the prescription for your area, first find the region in which you are working on Figure 6 and then refer to Appendix G.

Recommended seed mixtures are presented in Appendix H. These mixtures often contain species that cannot be obtained locally and must therefore be ordered from major seed suppliers in Vancouver. Check availability of seed mixes locally before commencing surface work. Table 3 gives some approximations regarding seeding and fertilizing to assist in the ordering of supplies.

TABLE 3

SOME APPROXIMATIONS REGARDING SEEDING AND FERTILIZING

1 hectare is equal to—an area 100 m by 100 m
—10,000 square metres
—2.47 acres

1 hectare is approximately equal to —1 km of road, 4-m road surface built across a slope.
—2 km of road, 4-m road surface built on level ground

1 kg is equal to 2.2 lbs.

1 lb. is equal to 0.45 kg

1 lb./acre is almost equal to 1 kg/ha

FIGURE 6

REGIONAL MAP TO BE USED IN CONJUNCTION WITH APPENDICES G AND H TO DETERMINE THE PRESCRIBED RECLAMATION TREATMENTS

The time of seeding is important in some areas of the province. Poor growth results if a frost or drought occurs immediately following germination. All seeding should therefore take place in the fall or early spring.

RECOMMENDED FERTILIZER APPLICATIONS

Although applications of fertilizer may not always be necessary they are always recommended. Fertilizer applications are relatively inexpensive compared to the costs involved in reseeding an area, and they ensure rapid germination and increase the chances of a successful catch.

The standard recommended fertilizer application is 300 kilograms per hectare of 13-16-10. A more concentrated fertilizer such as 19-19-19 may be used at 200 kilograms per hectare. Apply fertilizer by broadcasting on the soil surface at the time of seeding. Heavier applications are recommended where rapid growth is desired or on high elevation zones (Appendix G).

4.8 REVEGETATING WITH SHRUBS

Revegetation with native shrubs can be a valuable reclamation tool, particularly in highly sensitive areas such as recreation areas, alpine tundra and grasslands. Several characteristics of shrubs make them useful for reclamation work, especially when used with a grass/legume seed mix.

- **Erosion Control**

  Shrubs have deep woody roots which give mechanical support to slopes. When planted with grass they can help to avoid sloughing of the shallow sod layer. The woody top growth of shrubs can also help to stabilize reclaimed areas by reducing the surface wind velocity and its associated erosion.

- **Wildlife Habitat**

  Shrubs provide a good source of food and protective cover for wildlife. Ungulates make use of many species of shrubs as browse, especially during winter when other food sources are buried beneath snow.

- **Aesthetics**

  Shrubs are very useful for screening areas of activity from public view and for softening the harsh lines of disturbed sites.

Shrubs can be grown either from seed or from cuttings. Although the growth of root stock from seed is beyond the scope of most exploration projects, the collection of cuttings from the area surrounding an exploration site is certainly within the realm of any reclamation program. The following section describes principles and techniques used in the growth of shrubs from cuttings as applied to small reclamation projects.

SELECTION

The following factors should be considered in the selection of shrubs for use in reclamation:

- Shrubs used in revegetation work should be "pioneer" species, which are specifically adapted to invading an area after disturbance. They are tolerant of low moisture and nutrient conditions, and can withstand the temperature extremes typically experienced on disturbed sites. The best way to identify pioneer species is to look at areas of old disturbance near the site of the exploration project. The plants growing on these sites will have the greatest chance of success as reclamation species.

- Shrubs should be planted in areas with climatic conditions similar to the areas where they were originally grown. As a rule of thumb, seedlings should be planted within 166 metres (500 feet) elevation of where they were originally grown.

- The influence of aspect (direction of slope) should also be considered before planting. Shrubs grown on northern aspects are, in most cases, adapted to moist cool conditions and would grow poorly on dry, south-facing slopes. Similarly, shrubs grown on southern aspects would have poor success on north-facing slopes. In general, however, if shrubs are taken from areas with natural vegetation similar to that adjacent to the reclamation site, this type of problem can be avoided.

PROPAGATION

There are a number of different procedures for taking cuttings from the stems and roots of shrubs. The techniques described below should provide a high probability of success, although the best methods for a particular area or species must be determined through experimentation.

Hardwood Stem Cuttings

Hardwood cuttings may be taken during the autumn or early spring from dormant shoots of the past year's growth of deciduous species. The cuttings should be 15 to 20 centimetres long with the lowest cut 2 centimetres below a bud and the upper cut 2 centimetres above a bud. They should be planted vertically in the soil with the upper bud slightly above the soil surface.

Softwood Stem Cuttings

Softwood cuttings should be taken from leafy slips of the present year's growth of deciduous species. They should be 10 to 15 centimetres long with all but the top few leaves stripped off. The cuttings should be planted with the lowest leaf about 3 centimetres above the soil surface. The leaves stimulate rooting but can lead to the drying out of the cutting. In nurseries, these types of cuttings would normally be shaded in a coldframe or polyethylene tent. Since this will not be practical on an exploration program this method should only be used on moist or shaded sites.

Evergreen Stem Cuttings

Evergreen cuttings (from broadleaf evergreen and coniferous species) should be treated in the same way as softwood cuttings but must be prepared and planted in the early fall, after the first frosts. Cuttings may be taken from coniferous species such as juniper, or from broadleaf evergreens such as kinnikinnik. Pine, fir, balsam and spruce do not root well.

Root Cuttings

Root cuttings may often be taken from shrubs which have been uprooted by construction. They should be taken from young roots of about pencil thickness and cut into 5 to 8 centimetre lengths. Cuttings should be planted about 5 to 8 centimetres deep either horizontally or vertically, with the end cut from nearest the stem placed uppermost. This end will sprout and grow new stems.

The successful rooting of stem cuttings can be aided by wounding the base of the stem. This can be done by crushing or cutting with a knife so that the bark is broken in several places. The wounded area can then be treated with a rooting hormone to stimulate root initiation. Powdered hormone preparations are commercially available under names such as "Rootone" and "Seradix".

V.

APPENDICES

A Mines Act, Section 10

B Notice of Work on a Mineral Property

C Application for Approval of Underground Exploration Work

D Application for a Permit to Operate a Diesel Engine Underground

E Application for B.C. Explosives Storage and Use Permit

F Design of a Simple Pipe-stem Harrow

G Recommended Reclamation Treatments

H Suggested Seed Mixtures for Use on Areas Disturbed by Exploration Activities in British Columbia

I Addresses of Regulatory Agencies

APPENDIX A

Permits

10. (1) Before commencement of any work in, on or about a mine, the owner, agent or manager shall apply for and obtain a permit from the chief inspector and shall, as part of the application, file with the district inspector a plan outlining the details of the proposed work and a program for the protection and reclamation of the land and watercourses affected by the mine, including the information, particulars and maps established by the regulations or the code.

(2) Notwithstanding subsection (1), where the chief inspector is satisfied that, because of the nature of the proposed work, it is not necessary to obtain a permit, he may exempt in writing the owner, agent or manager from the requirement to comply with this section with respect to the proposed work.

(3) Where the chief inspector considers the application for a permit is satisfactory he may issue the permit, and the permit may contain conditions that the chief inspector considers necessary.

(4) The chief inspector may, as a condition of issuing a permit under subsection (3), require that the owner, agent or manager give security in the amount, form and subject to conditions specified by the chief inspector

(a) for mine reclamation, and

(b) to provide for protection of, and mitigation of damage to, watercourses affected by the mine.

(5) Where required by the chief inspector, the owner, agent or manager shall, in each year, deposit security in an amount and form satisfactory to the chief inspector so that, together with the deposit under subsection (4) and calculated over the estimated life of the mine, there will be money necessary to perform and carry out properly

(a) all the conditions of the permit relating to the matters referred to in subsection (4) at the proper time, and

(b) all the orders and directions of the chief inspector or an inspector respecting the fulfillment of the conditions relating to the matters referred to in subsection (4).

(6) The owner, agent or manager, or an inspector, may apply to the chief inspector for a revision of the conditions or an extension of the term of a permit issued under this section, and the chief inspector may revise the conditions or extend the term, as the case may be, and, where he considers it necessary, the chief inspector may impose additional conditions or changes in the existing conditions, including changes to the security required or the term of the permit, with or without an application under this section.

(7) Where the owner, agent or manager fails to perform and complete the program for reclamation or comply with the conditions of the permit to the satisfaction of the chief inspector, the chief inspector, after giving notice to remedy the failure, may

(a) cancel the permit and order the owner, agent or manager to stop the mining operation, and

(b) apply all or part of the security toward payment of the cost of the work required to be performed or completed.

(8) The manager shall maintain a valid and subsisting permit and no work shall take place in, on or about a mine without one.

APPENDIX B

Province of British Columbia

Ministry of Energy, Mines and Petroleum Resources
MINERAL RESOURCES DIVISION
ENGINEERING AND INSPECTION BRANCH

NOTICE OF WORK ON A MINERAL PROPERTY

Application for Approval of a Work and Reclamation Program
(Pursuant to Section 10 of the Mines Act,1989)

This form is to be completed and signed by any company or individual planning to conduct exploration or other work on a mineral property involving; the use of mechanical equipment likely to cause disturbance of the land; induced polarization surveys; or significant tree or line cutting. Keep one copy. Forward one copy to the District Inspector of Mines. Approval must be obtained prior to commencement of work. The approval process may involve referral to other agencies for their comments and/or gazetting and may take up to 60 days. If underground exploration or development is contemplated, an additional 'Underground Exploration Work Application for Approval' form must be completed.

1. **PROPERTY NAME**

If a previous Approval of Work exists for this property, please provide:
Previous Approval Number and/or Permit No.

2. NAME OF APPLICANT

COMPANY NAME (if applicable)

APPLICANT'S TITLE OR POSITION

ADDRESS

CITY PROVINCE POSTAL CODE

TELEPHONE NO. FAX NO.

Please indicate if the applicant (or company) is any or all of the following:
❒ Operator of the operation ❒ Owner of the operation
❒ Manager (in accordance with Section 21 of the Mines Act)

4. **Duration** of planned work from _____

to _____

5. **Number of claims** **Principal Claim Group**

3. If the Owner, Operator or Manager are other than the applicant, please complete their addresses below:

a) **OPERATOR:** ❒ Same as for previous Approval Number, or

NAME

ADDRESS

CITY PROVINCE POSTAL CODE

TELEPHONE NO. FAX NO.

b) **OWNER** of the operation: ❒ Same as for previous Approval Number, or

NAME

ADDRESS

CITY PROVINCE POSTAL CODE

TELEPHONE NO. FAX NO.

c) **MANAGER**: (The individual responsible for the operation in accordance with Section 21 of the Mines Act) ❒ Same as for previous Approval Number, or

NAME

ADDRESS

CITY PROVINCE POSTAL CODE

FIELD TELEPHONE NO. FAX NO.

6. Are the surface rights to any of the land on which the operation is located privately owned? ❒ Yes ❒ No If yes, give the District Lot number(s)

NAME AND ADDRESS OF THE PRIVATE LANDOWNER

7. GENERAL **LOCATION OF PROPERTY**: (Also show on map or plan).

Is any part of this property designated as a Recreational Area? ❒ Yes ❒ No Mining Division _____ _____

NTS Map sheet (eg.82E/9E)_____ Latitude _____°_____' Longitude _____°_____

8. ACCESS DIRECTIONS: FROM (Nearest town or major road intersection)_____

FOLLOW _____ ___ KMS (S.E.N.W) TO _____ FOLLOW _____ ___ KMS (S.E.N.W) TO _____

FOLLOW _____ ___ KMS (S.E.N.W) TO _____ FOLLOW _____ ___ KMS (S.E.N.W) TO _____

FOLLOW _____ ___ KMS (S.E.N.W) TO _____ FOLLOW _____ ___ KMS (S.E.N.W) TO _____

or otherwise describe access as _____

Form 1 91 04

APPENDIX B (continued)

9. **DESCRIPTION OF WORK:** BLASTING ❒ Yes ❒ No GEOPHYSICAL ❒ Yes ❒ No GEOCHEMICAL ❒ Yes ❒ No
LINE CUTTING ❒ Yes ❒ No PERCUSSION DRILLING ❒ Yes ❒ No CLEARING TREES ❒ Yes ❒ No DIAMOND DRILLING ❒ Yes ❒ No

BRIEFLY DESCRIBE OPERATION (if other than above)

BLASTING: If blasting is involved give details of explosives, magazines, etc. (Subject to approval of the District Inspector):

Give Number of Existing Storage permit _____ or application for a permit is Attached (Y/N) _____

10. **WATER SUPPLY** (subject to approval under the Water Act): If stream give name _____ draining to _____
Name or describe the source of water supply _____
Quantity of water to be used _____ c.f.s. Location of water intake (show on plan) _____
11. **WASTE WATER TREATMENT** including disposal of drilling mud and sludge (Subject to approval under the Waste Management Act): Describe treatment and disposal facilities (size of settling pond, recycling, distance to nearest stream,etc.) (Show on plan)

12. **SURFACE DISTURBANCE** OFF THIS MINERAL PROPERTY:
Road Access construction: Total length _____ m Approx. width _____ m Area _____ m²
Campsite No. of people: _____ length _____ m width _____ m Area _____ m²
Other: Describe _____ Area _____ m²

13. SURFACE DISTURBANCE ON THIS MINERAL PROPERTY:
Settling ponds: No _____ length _____ m width _____ m Area _____ m²
Road Access construction: Total length _____ m Approx. width _____ m Area _____ m²
Drilling: No. of sites _____ depth _____ length _____ m width _____ m Area _____ m²
Trenching: No. of trenches _____ depth _____ length _____ m width _____ m Area _____ m²
Campsite: No. of people _____ length _____ m width _____ m Area _____ m²
Test Pits: No. of pits _____ depth _____ length _____ m width _____ m Area _____ m²
Estimated number of workers _____
Underground work: Area of surface disturbance length _____ m width _____ m Area _____ m²
Rock Dumps: Area of surface disturbance length _____ m width _____ m Area _____ m²
Other: Describe _____ Area _____ m²
TOTAL AREA OF SURFACE DISTURBANCE _____ m² (1 ha = 10,000 m²) _____ ha
EXISTING DISTURBANCE _____ m² ADDITIONAL DISTURBANCE THIS YEAR _____ m² PLANNED RECLAMATION THIS YEAR _____ m²

14. **PRESENT STATE OF LAND** ON WHICH WORK IS PROPOSED:
Present Land Use (agriculture, forestry, etc.) _____ Type of Vegetation _____
Access Roads (Present use and condition) _____
Old workings (location, condition) _____

15. **RECLAMATION PROGRAM**: Proposed land use after reclamation _____
Describe protective measures and proposed site reclamation methods with reference to the items listed below. Attach separate sheets and plan, if necessary:
Topsoil handling (where applicable _____
Camp sites _____
Trenches, Drill sites, Major excavations _____
Roads _____
Revegetation of disturbed areas _____
Other _____

16. **EQUIPMENT** LIST Indicate make, number, size and capacity (all equipment to comply with the Mining Code):
(a) _____ (b) _____
(c) _____ (d) _____
(e) _____ (f) _____
(g) _____ (h) _____
17. **FIRST AID FACILITIES** (describe - including methods of communication and emergency transportation): _____
_____ Location of nearest hospital _____ Travel time to hospital _____

18. **UNDERGROUND WORK** ❒ Yes ❒ No If yes - attach a completed 'Underground Exploration Work Application for Approval' form.
19. Is any part of this property designated as a **Uranium/Thorium Area**? ❒ Yes ❒ No . If yes - has a survey been completed? ❒ Yes ❒ No Gazette Date _____

PRINT NAME OF APPLICANT _____ SIGNATURE OF APPLICANT _____ DATE OF APPLICATION _____

20. **ATTACH A PLAN (OR PLANS) OF THE PROPOSED OPERATIONS (which may be drawn on 8-1/2" x 11" photocopies of standard map sheets of an appropriate scale 1:250000; 1:50000; 1:20000; 1:5000; 1:2000 etc. showing location of property, access to property, location of work and roads, watercourses, working areas, proposed grid layouts, camp and other surface facilities.)**

APPENDIX C

Province of British Columbia

Ministry of Energy, Mines and Petroleum Resources
MINERAL RESOURCES DIVISION
ENGINEERING AND INSPECTION BRANCH

UNDERGROUND EXPLORATION WORK

Application for Approval
(Pursuant to Section 10 of the Mines Act.1989)

Under Section 10 of the Mines Act, the owner agent or manager of the mine must have the written approval of the Chief Inspector of Mines before working underground. To obtain approval, this form must be completed and submitted to the District Inspector of Mines for transmittal to the Chief Inspector of Mines. The application must also include:

1. Proposed work outline and reclamation program on an appropriate Notice of Work form.
2. In addition to the plans required for the Notice of Work, a detailed map of present and proposed undergound workings.
3. A detailed plan of surface installations in relation to mine openings.

1. PROPERTY NAME _____

2. MINING DEVELOPMENT DETAIL

Type of Development (raise, sub-level, drift, etc.)_____

Proposed Length_____ Dip or grade_____

3. UNDERGROUND VENTILATION Note: A minimum airflow of 15.4 m³/min per m² of face is required for mining development ventilation.

Heading Size: Height_____m Width_____m

Type size, and location of fan_____

Size of ventilation ducting_____ Ventilating airflow in m³/min supplied to working face_____

Special comments_____

4. UNDERGROUND DRILLING

Approximate number of holes_____ Drilling pattern_____

Will a bit sharpener be on the property? Yes ☐ No ☐

5. EXPLOSIVES AND BLASTING PROCEDURES

Have you obtained an explosives storage and use permit (Licensed Magazine)? Yes ☐ The permit number is _____

If not, have you applied for an approved explosives storage magazine? Yes ☐ No ☐

Type of Explosives to be used _____ Detonation method: electric fuse and cap etc. _____

6. MUCK REMOVAL

Specify in detail, the system to be used: _____

7. DUMPING PROCEDURES Specify in detail, the system to be used:_____

8. EQUIPMENT IN USE Indicate make, model, number, size and capacity of all drilling, mucking, tramming, ventilation and other equipment. Include Diesel Permit number where applicable.

(a)_____ (b)_____

(e)_____ (f)_____

9. GROUND CONTROL

Timbering: size and type (square sets, post and lagging, spacing etc.)_____

Rockbolting: size and type (pattern, length of bolts, screening or strapping, etc.)_____

10. WORK SUPERVISION

Shift Boss name _____ Certificate Number_____

Number of Employees per shift_____ Total number of Employees_____ Shift schedule_____ Others_____

11. ELECTRICAL INSTALLATION Date Notice of Electricity Introduction was submitted:_____ Attach a schematic diagram of installation and a plan of underground mine showing location of electrical equipment, routing size and type of cables.

12. PRESENCE OF WATER OR MATERIAL WHICH FLOWS WHEN WET Water level above/below workings _____m

Proposed precautions_____

13. FIRE FIGHTING EQUIPMENT AND PROVISIONS Describe in detail _____

14. MINE RESCUE EQUIPMENT ON SITE Indicate type, make, model, and quantity.

(a)_____ (b)_____

(c)_____ (d)_____

Form 4-91 04

APPENDIX D

Province of British Columbia
Ministry of Energy, Mines and Petroleum Resources
MINERAL RESOURCES DIVISION
INSPECTION AND ENGINEERING BRANCH

APPLICATION FOR A PERMIT TO OPERATE A DIESEL ENGINE UNDERGROUND

(To be forwarded in duplicate to District Inspector of Mines)

COMPANY ..... NAME OF MINE .....

ADDRESS .....

LOCATION IN MINE (Submit Plan Showing Ventilation Details With Initial Application) .....

.....

MAXIMUM OPERATING ELEVATION (ABOVE OR BELOW SEA LEVEL) .....

TYPE OF EQUIPMENT (Locomotive, Tractor, Etc.) ..... Company Vehicle No. .....

PURCHASED FROM .....

Manufacturer and Model .....

Serial No. of Chassis or Vehicle .....

Overall Dimensions of Equipment .....

Fire Suppression Equipment: Type ..... Size ..... Location .....

Hydraulic Fluids: Type ..... Quantity ..... Function .....

Fuel Tank Capacity .....

If a Vehicle, Maximum Grade on Which Vehicle Will Be Operated .....

Is it Fitted With (a) Rollover Protection .....

(b) Emergency Steering .....

(c) Seat Belts .....

ENGINE: Make and Model ..... Rated brake power (kw) at governed engine speed (r/min.) .....

2 or 4 Cycle ..... No. of Cylinders .....

Engine Serial No. ..... Displacement cm^3 .....

Starting Mechanism (Air, Battery, Etc.) .....

Details of Approval Plate or Certificate, Including Ventilation Requirements, If Known .....

.....

Details of Exhaust Conditioning:

Dimensions and Type of Conditioner .....

Water Capacity (Wet Scrubbers) .....

Location of Repair and Fueling Arrangements (Submit Plan if Underground) .....

.....

Fuel Specifications: ..... Flash Point: ..... Sulphur Content .....

Date _____ _____

Mine Manager

APPENDIX E

Province of British Columbia
Ministry of Energy, Mines and Petroleum Resources

APPLICATION FOR B.C. EXPLOSIVES STORAGE & USE PERMIT FOR MINING PURPOSES

1. COMPANY NAME: _____

2. BUSINESS ADDRESS: _____

3. TELEPHONE NO.: _____

4. MANAGER: _____

5. LOCATION OF MAGAZINE: (Accompanied by scaled plan of area showing magazines, road and dwelling locations and Claim Name.)

6. POWDER MAGAZINE:

Magazine No.	Type of Construction	Size L W H	Maximum Quantity	Distance to Dwelling	Nearest Road	Type of Explosives

7. CAP MAGAZINE:

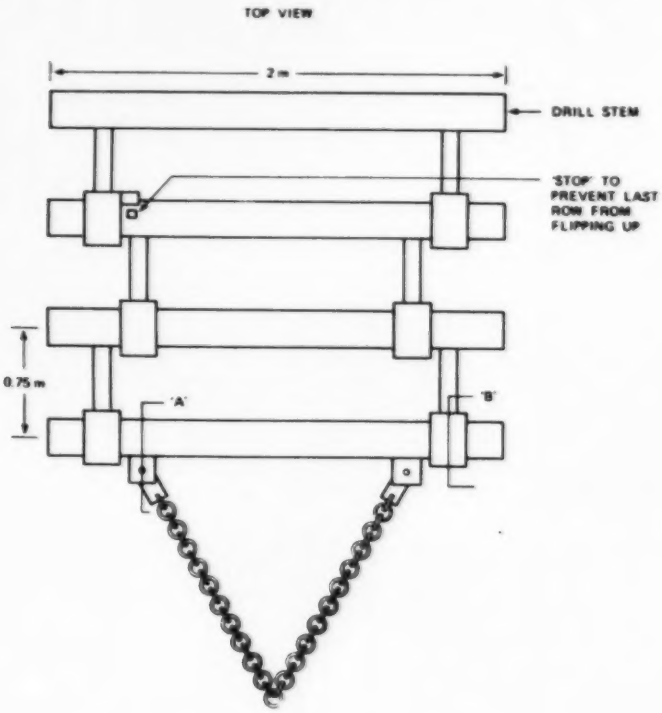
Magazine No.	Type of Construction	Size L W H	Maximum Quantity	Distance to Dwelling	Nearest Road	Type of Caps

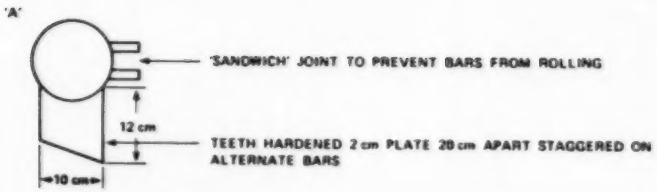
DATE: _____ MANAGER'S SIGNATURE: _____

REMARKS:

APPENDIX F

DESIGN FOR A SIMPLE PIPE-STEM HARROW




'A'
'SANDWICH' JOINT TO PREVENT BARS FROM ROLLING
12 cm
TEETH HARDENED 2 cm PLATE 20 cm APART STAGGERED ON ALTERNATE BARS
10 cm

APPENDIX G

RECOMMENDED RECLAMATION TREATMENTS

COASTAL REGION

BIO-GEOCLIMATIC ZONE	DESCRIPTION	ELEVATION	RECLAMATION TREATMENTS				
			SEEDING			FERTILIZER	
			Mix-ture	Rate *kg/ha*	Timing	Type	Rate *kg/ha*
Coastal Douglas Fir	—includes the east coast of Vancouver Island south of Kelsey Bay, the Sunshine Coast, and the Fraser Valley —annual precipitation high, 66-152 cm (26-60") —summers dry, winters mild —characterized by the following trees: Douglas fir, grand fir, western red cedar, arbutus, Garry oak (dry areas), lodgepole pine, Sitka spruce, bitter cherry, vine maple, bigleaf maple, and red alder	Southeastern Vancouver Island 0-450 m (0-1500') South Coast of Mainland 0-150 m (0-500')	I	30	avoid July and August seeding	13-16-10 (19-19-19)	300 (200)
Coastal Western Hemlock and Coastal Cedars Pine Hemlock	—includes most of Vancouver Island and the Queen Charlotte Islands (excluding mountain tops), and the river valleys of the Pacific Coast —annual precipitation very high, 112-665 cm (44-262"); mild winters and summers —characterized by the following trees: Douglas fir, western red cedar, yellow cedar, shore pine, western hemlock, Sitka spruce, western white pine, grand fir (in dry areas), Pacific silver fir (wet areas)	South—windward side 0-900 m (0-3000') South—leeward side 450-1050 m (1500-3500') North 0-300 m (0-1000')	I	30	no restrictions	13-16-10 (19-19-19)	300 (200)
Mountain Hemlock	—includes areas of high elevation on Pacific West Coast, Vancouver Island, and the Queen Charlotte Islands —annual precipitation high, 178-432 cm (70-170"); heavy snow cover over unfrozen ground; winters not severe —characterized by the following trees: mountain hemlock, Pacific silver fir, yellow cedar, western hemlock, western red cedar	South—windward side 900-1500 m (3000-5000') South—leeward side 1050-1800 m (3500-6000') North—300-900 m (1000-3000')	I or II	60	no restrictions	13-16-10 (19-19-19)	300 (200)
Alpine	—includes areas of high elevation, with heavy snow cover and long snow duration —low stunted growth of alpine fir, whitebark pine, mountain hemlock	windward side above 1500 m (5000') leeward side above 1800 m (6000')	VII	60	seed in early spring or late fall only	13-16-10 (19-19-19)	500 (400)

APPENDIX G (continued)

RECOMMENDED RECLAMATION TREATMENTS—*Continued*

SOUTHERN INTERIOR REGION

BIO-GEOCLIMATIC ZONE	DESCRIPTION	ELEVATION	RECLAMATION TREATMENTS				
			SEEDING			FERTILIZER	
			Mix-ture	Rate *kg/ha*	Timing	Type	Rate *kg/ha*
Ponderosa Pine Bunchgrass	—includes the dry river valleys of the Fraser, Thompson, Nicola, Similkameen, and Okanagan —very low precipitation, 19-36 cm (7.4-14") —characterized by the following vegetation: ponderosa pine, bitter brush, sagebrush, and bunchgrass	270-750 m (900-2500')	III	30	no restrictions early spring preferred	13-16-10 (19-19-19)	300 (200)
Interior Douglas Fir	—includes the majority of the dry Southern Interior below 1350 m (4500') —precipitation low, 36-56 cm (14-22"), hot summers and cool winters —characterized by the following trees: Douglas fir, ponderosa pine, western white pine, white spruce, western red cedar, lodgepole pine, larch, aspen, black cottonwood, common paper birch, and Rocky Mountain maple	300-1350 m (1000-4500')	IV or V	30	early spring or late fall preferred	13-16-10 (19-19-19)	300 (200)
Interior Cedar Hemlock	—includes Interior valleys, 360-1260 m (1200-4200'), east of the Selkirk Mountains —precipitation high, 56-170 cm (22-67"), warm summers and cool winters —characterized by the following trees: western hemlock, Douglas fir, western white pine, lodgepole pine, western red cedar, Engelmann spruce, white spruce, alpine fir, grand fir, black cottonwood, aspen, common paper birch, larch	360-1260 m (1200-4200')	I	30	no restrictions	13-16-10 (19-19-19)	300 (200)
Engelmann Spruce Subalpine Fir and Montane Spruce	—includes most areas greater than 1260 m (4200') in eastern British Columbia, south of Prince George —subalpine with moderate snow cover and severe winters; precipitation high, 41-183 cm (16-72") —characterized by the following trees: Engelmann spruce, alpine fir, lodgepole pine, white bark pine, alpine larch, limber pine, Douglas fir, western white pine	1260-2250 m (4200-7500')	VI	30	no restrictions	13-16-10 (19-19-19)	300 (200)
Alpine	—includes areas in southeastern British Columbia at high elevations —low stunted trees: Engelmann spruce, alpine fir, white bark pine, alpine larch, alpine meadows and tundra	greater than 2250 m (7500')	VII	30	seed in early spring or late fall only	13-16-10 (19-19-19)	500 (400)

APPENDIX G (continued)

RECOMMENDED RECLAMATION TREATMENTS—*Continued*

CENTRAL AND NORTHERN INTERIOR REGION

BIO-GEOCLIMATIC ZONE	DESCRIPTION	ELEVATION	RECLAMATION TREATMENTS				
			SEEDING			FERTILIZER	
			Mixture	Rate kg/ha	Timing	Type	Rate kg/ha
Subboreal Spruce	—includes most of the central interior with elevation 330-840 m (1100-2800') north of Williams Lake and south of Germansen Landing —heavy snow cover; severe winters; precipitation moderate, 40-64 cm (16-25") —characterized by the following trees: lodgepole pine, white spruce, alpine fir, black spruce, aspen, black cottonwood, common paper birch	Central 330-840 m (1100-2800')	V	30	no restrictions	13-16-10 (19-19-19)	300 (200)
Engelmann Spruce Subalpine Fir	—includes areas of the central interior above 1050 m (3500') —subalpine with moderate snow cover and severe winters; precipitation high, 41-183 cm (16-72") —characterized by the following trees: Engelmann spruce, alpine fir, lodgepole pine, white spruce, white bark pine	Central and Northeast 1050-1650 m (3500-5500') Northwest 900-1500 m (3000-5000')	VI	30	no restrictions	13-16-10 (19-19-19)	300 (200)
Boreal White and Black Spruce	—includes all areas below 840 m (2800') in the northern interior —moderate or light snow cover over deeply frozen ground; winters severe; moderate precipitation, 30-58 cm (12-23") —characterized by the following trees: white spruce, black spruce, tamarack, alpine fir, aspen, thin-leaved mountain alder, common paper birch, black cottonwood	Northeast and Northwest 163-840 m (550-2800')	VI	30	no restrictions	13-16-10 (19-19-19)	300 (200)
Spruce Willow Birch and Alpine	—includes all high elevation areas in the northern interior —moderate snow cover —characterized by stunted tree growth of alpine fir and scrub glandular birch; alpine tundra occurs at higher elevations	Northeast greater than 1650 m (5500') Northwest greater than 1500 m (3500')	VII	60	seed in early spring or late fall	13-16-10 (19-19-19)	500 (400)

APPENDIX H

SUGGESTED SEED MIXTURES FOR USE ON AREAS DISTURBED BY EXPLORATION ACTIVITIES IN BRITISH COLUMBIA

Mixture	Biogeoclimatic Zone	Species	% by wt.
I	Coastal Douglas Fir Coastal Western Hemlock Interior Cedar Hemlock Coastal Cedars Pine Hemlock	Timothy	10
		Perennial Rye	20
		Orchard Grass	15
		Creeping Red Fescue	20
		Canada Bluegrass	5
		White Dutch Clover	30
II	Mountain Hemlock	Orchard Grass	40
		Creeping Red Fescue	40
		Perennial Rye	10
		White Dutch Clover	10
III	Ponderosa Pine Bunch Grass	Crested Wheatgrass	70
		Alfalfa	30
IV	Interior Douglas Fir (dry)	Streambank Wheatgrass	30
		Crested Wheatgrass	40
		Alfalfa	15
		Sainfoin	15
V	Interior Douglas Fir (wet) Sub-boreal Spruce	Creeping Red Fescue	30
		Timothy	20
		Orchard Grass	20
		Alsike Clover	30
VI	Engelmann Spruce Subalpine Fir Boreal White and Black Spruce Montane Spruce	Creeping Red Fescue	40
		Timothy	40
		Alsike Clover	20
		(Red Top)	
VII	Alpine Tundra Spruce Willow Birch	Meadow Foxtail	10
		Creeping Red Fescue	40
		Timothy	25
		Tracenta Bentgrass	10
		Alsike Clover	15

APPENDIX I

ADDRESSES OF REGULATORY AGENCIES

MINISTRY OF ENERGY, MINES AND PETROLEUM RESOURCES		Phone	Facsimile
Chief Inspector of Mines	Rm. 105, 525 Superior St., Victoria	356-2200	387-5985
Manager, Reclamation & Permitting	Rm. 105, 525 Superior St., Victoria	356-2214	387-5985
Regional Mining Engineers and District Inspectors of Mines			
Fernie	Bag 1000, Cranbrook Rd.	423-6884	423-3194
Kamloops	200 - 2985 Airport Dr.	828-4566	828-4726
Nanaimo	1A - 3411 Shenton Rd.	755-2486	755-2474
	Vancouver callers	660-9364	
Nelson	310 Ward St. (mail)	354-6125	354-6120
	403 Vernon St. (office)		
Prince George	1652 Quinn St.	565-6125	565-6015
Smithers	Bag 5000, 3793 Alfred Ave.	847-7383	847-7603
GOLD COMMISSIONER OFFICES			
Alberni	4515 Elizabeth St., Port Alberni	724-9200	724-9298
Atlin	Box 100, Atlin	651-7595	651-7707
Cariboo	102 - 350 Barlow Ave., Quesnel	992-4301	992-4314
Clinton	Box 70, Clinton	459-2268	459-7922
Fort Steele	100 Cranbrook St. N., Cranbrook	426-1211	426-1253
Golden	Box 39, Golden	344-7550	344-7553
Greenwood	Box 850, Grand Forks	442-5444	442-5467
Kamloops	250 - 455 Columbia St., Kamloops	828-4540	828-4542
Liard	800 Hornby St., Vancouver	660-2672	660-2653
Lillooet	Court House, Bag 700, Lillooet	256-7548	256-4546
Nanaimo	13 Victoria Crescent, Nanaimo	755-2200	755-2222
Nelson	310 Ward St., Nelson	354-6104	354-6102
New Westminster	100 - 635 Columbia St., New Westminster	660-8666	660-8683
Nicola	Bag 4400, Merritt	378-9343	378-9346
Omineca	Bag 5000, 1020 Mur.ay St., Smithers	847-7207	847-7232
Osoyoos	Rm. 112, Court House, 100 Main St., Penticton	492-1211	492-1213
Revelstoke	Box 380, Revelstoke	837-7636	837-7640
Similkameen	Box 9, Princeton	295-6957	295-3070
Skeena	100 Market Place, Prince Rupert	627-0415	627-0421
Slocan	Box 580, Kaslo	353-2219	353-2316
Trail Creek	Box 910, Rossland	362-7324	364-0561
Vancouver	302 - 865 Hornby St., Vancouver	660-2672	660-2653
Vernon	3201 - 30th St., Vernon	549-5511	549-5508
Victoria	525 Superior St., Victoria	387-4417	387-3594
MINERAL TITLES INSPECTORS			
Kamloops	250 - 455 Columbia St., Kamloops	828-4569	828-4233
Nelson	310 Ward St., Nelson	354-6127	354-6120
Quesnel	Box 11, 350 Barlow Ave., Quesnel	992-4222	992-4314
Vancouver	302 - 865 Hornby St., Vancouver	660-2672	660-2653
Victoria	525 Superior St., Victoria	356-2251	387-3594

APPENDIX I (continued)

B.C. LANDS		Phone	Facsimile
Burnaby	401 - 4603 Kingsway.	660-5500	660-5538
Cranbrook	828A Baker St.	426-1414	426-1426
Fort St. John	220, 9900 - 100th Ave.	787-3411	787-3219
Kamloops	478 St. Paul St.	828-4800	828-4809
Prince George	1011 Fourth Ave.	565-6245	565-6941
Smithers	3726 Alfred Ave.	847-7334	847-7556
Victoria	851 Yates St.	387-5011	356-1871
Williams Lake	201 - 172 North 2nd Ave.	398-4250	398-4296
B.C. PARKS			
Kamloops	101 - 1050 West Columbia Ave.	828-4501	828-4737
Prince George	430 - 1011 Fourth Ave.	565-6270	565-6429
Vancouver	1610 Mt. Seymour Dr.	929-1291	929-2425
B.C. ENVIRONMENT - FISH AND WILDLIFE BRANCH			
Kamloops	1259 Dalhousie Dr.	374-9717	828-4000
Nanaimo	2569 Kenworth Rd.	758-3951	755-2473
Nelson	617 Vernon St.	354-6344	354-6332
Penticton	201 - 3547 Skaha Lake Rd.	493-8261	492-1314
Prince George	1011 Fourth Ave.	565-6145	565-6629
Smithers	Bag 5000, 3726 Alfred Ave.	847-7303	847-7591
Surrey	10334 - 152A St.	584-8822	660-8926
Williams Lake	540 Borland St.	398-4530	398-4214
B.C. ENVIRONMENT - ENVIRONMENTAL PROTECTION PROGRAM			
Kamloops	1259 Dalhousie Dr.	374-9717	828-4000
Nanaimo	2569 Kenworth Rd.	758-3951	755-2473
Nelson	617 Vernon St.	354-6355	354-6367
Penticton	201 - 3547 Skaha Lake Rd.	493-8261	492-1314
Prince George	1011 Fourth Ave.	565-6155	565-6629
Smithers	Bag 5000, 3726 Alfred Ave.	847-7260	847-7591
Surrey	10334 - 152A St.	584-8822	660-8926
Williams Lake	540 Borland St.	398-4531	398-4214
B.C. ENVIRONMENT - WATER MANAGEMENT BRANCH			
Kamloops	1259 Dalhousie Dr.	374-9717	828-4000
Nanaimo	2569 Kenworth Rd.	758-3951	755-2473
Nelson	617 Vernon St.	354-6370	354-6332
Penticton	201 - 3547 Skaha Lake Rd.	493-8261	492-1314
Prince George	1011 Fourth Ave.	565-6160	565-6629
Smithers	Bag 5000, 3726 Alfred Ave.	847-7278	847-7591
Surrey	10334 - 152A St.	584-8822	660-8926
Williams Lake	540 Borland St.	398-4531	398-4214
MINISTRY OF FORESTS			
Burnaby	4595 Canada Way	660-7500	660-7778
Kamloops	515 Columbia St.	828-4131	828-4154
Nelson	518 Lake St.	354-6200	354-6250
Prince George	1011 Fourth Ave.	565-6100	565-6671
Smithers	Bag 5000, 3726 Alfred Ave.	847-7500	847-7217
Williams Lake	540 Borland St.	398-4345	398-4380

APPENDIX I (continued)

DEPARTMENT OF FISHERIES AND OCEANS		Phone	Facsimile
District Offices			
Campbell River	215 - 950 Alder St.	287-2102	
Kamloops	202 - 317 Seymour St.	374-4322	
Nanaimo	305 - 80 Front St.	754-0204	
New Westminster	301 - 80 Sixth St.	666-2618	
Port Alberni	3019 Fourth Ave.	724-0195	
Prince Rupert	109 - 417 Second Ave. West	624-0451	627-3054
Queen Charlotte City	Box 99	559-4413	
Victoria	423 - 1230 Government St.	388-3252	
Whitehorse	122 Industrial Rd.	(403) 667-2235	668-6829
Habitat Management Offices			
Kamloops	202 - 317 Seymour St.	374-4322	
Nanaimo	305 - 80 Front St.	754-0204	
New Westminster	330 - 80 Sixth St.	666-0315	
Prince George	2392 Ospika Blvd.	561-5366	561-5534
Whitehorse	122 Industrial Rd.	(403) 667-2235	668-6829